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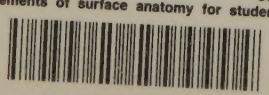

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ELEMENTS OF SURFACE ANATOMY

ELEMENTS OF SURFACE ANATOMY

FOR STUDENTS OF MEDICINE

BY

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"*To the Courteous Reader*

"It may bee, that ſome nice Criticke, of the poſteritie of Aristarchas or Palemon, hauing taken a view of this Booke, wil pronounce it altogether vnneceſſarie, both by reaſon of the matter and of the Language. . . . If ſuch a one wil ſo iudge becauſe he fixeth his eies onely vpon thoſe who are equall with the Authors in this kinde of ſtudie, his cenſure may paſſe. But if any man of ſolid iudgement will but conſider the proficient, or him who onely by deſultorie inſpection, laboureth to delight himſelfe, he muſt out of all doubt think otherwiſe. . . . The Printer therefore . . . hath publiſhed this ſmall Manuell, hoping it will prooue profitable and delightfull . . . desiring the Readers acceptance, becauſe it proceedeth fro a mind deſirous to giue ſatisfaction to all. Thus much I thought good to inſinuate vnto thee, ſeeing we liue in a miſconſtruing Age."

From *A Description of the Body of Man*,
by Alexander Rhead. **1616.**

747
1925

PREFACE

This little book has been written primarily in response to a need felt in our own department.

The following are believed to be its principal features :—

(1) The number of structures described is limited to those the surface anatomy of which is deemed likely to be of importance to the general practitioner and of which it seems reasonable to expect a knowledge on the part of the undergraduate.

(2) The structures described receive an amount of attention which is roughly proportionate to their importance in general practice—*i.e.* there is some attempt at perspective.

(3) In some instances suggestions are put forward for the correlation of the facts of surface anatomy with those of ordinary descriptive anatomy.

(4) Mention is made of the clinical significance of many of the matters discussed.

(5) Pains have been taken to make the descriptions as clear as possible by the use of several kinds of type and of a system of indentation—amounting almost to tabulation—in many places. It is hoped that this may facilitate assimilation and revision.

For the sake of keeping the book small the following have been omitted, since they are satisfactorily described in other works in the possession of every student : the surface appearances of the eye, the ear, the nose, the mammae and the external genitalia ; likewise the anatomy of the various cavities commonly

examined from the exterior—the ear, the eyeball, the nose, the mouth, the pharynx, the larynx, the rectum, the vagina and the bladder.

The references to the clinical significance of many of the facts mentioned are inserted after much consideration and in realisation of the fact that there is room for considerable difference of opinion concerning the desirability thereof. They are introduced with little or no thought of imparting instruction in applied anatomy, but rather with the intention of illustrating to the student the importance of correlating the different subjects of the curriculum, especially the pre-clinical and the clinical subjects, and in the hope of adding to the interest of his anatomical studies. While its immediate practical applications do not constitute the sole source of the interest which attaches to the study of anatomy, they do constitute one very live and, surely, a thoroughly legitimate source of such interest, always provided that the laying of a solid anatomical foundation be not neglected for the more tempting pastime of tinkering with the clinical superstructure. The teacher who exercises a wise guiding influence over his students will have little difficulty in controlling this.

It is possible that some senior students may find the book useful for purposes of revision.

An English translation of the B.N.A. is employed almost exclusively, the old names being inserted in parentheses the first time each term occurs. A little latitude in the matter of nomenclature has been exercised in certain places, however. With a few exceptions the English translation of the B.N.A. has alone been indexed.

The author begs to express his thanks to Professors C. F. Martin, S. E. Whitnall and J. C. Simpson for

encouragement during the progress of the work, and to Dr F. J. Tees for assistance with the clinical points. The courteous co-operation of the publishers has lightened the task and added pleasure thereto.

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August 1925.

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INTRODUCTION

In the majority of schools of medicine it is held that no matter what branch of medicine a person may ultimately pursue, his earliest training should be upon broad general lines such as would fit him for general practice, and the undergraduate course is designed to this end.

Anatomy has long been most intimately associated with surgery, and particularly with operative surgery, but it must not be forgotten that it is of significance in all branches of medicine, albeit the nature and the degree of its importance vary in the different subjects.

It is obvious that the examination of every patient involves a knowledge of surface anatomy. A specialist in surgery operates upon a high percentage of the patients whom he examines, so that for him an especially sound knowledge of ordinary descriptive anatomy, as well as of surface anatomy, is essential. But the general practitioner examines very many more patients than he operates upon, so that, regarded solely from the point of view of clinical application, for him surface anatomy assumes a *relative* importance which is very great indeed. For this reason the student should devote particular attention to surface anatomy, for even a reasonable knowledge thereof can be acquired only by assiduous and conscientious study.

The fundamental aim of surface anatomy is the visualisation of the structures which lie beneath the skin and are hidden by it. It has been said that we must be able, in our mind's eye, to see through the

skin as through a transparent veil. Sir Auckland Geddes has stated the matter thus: ". . . We must never lose sight of the operating surgeon and the lone practitioner. We must teach them to see clearly where no human eye can see. We must endeavour so to teach the details of structure that every little elevation, every pulse, every tendon, every bony point, tells its tale to the examining finger. It will be well when we can induce our students to learn from the blind something of the powers of touch, so that the hand of the practitioner may be as an X-ray apparatus to him, by means of which he can know of the things he cannot see."

Pre-eminently a practical subject, surface anatomy cannot be learned satisfactorily without being *done*. Moreover, surface anatomy cannot be taught—it can only be studied. No amount of reading, looking at illustrations, note-taking, or witnessing demonstrations will ever educate the tactile and visual senses so as to confer a working knowledge of the subject. The student's first attempt to mark in the lungs and pleurae without assistance upon the living body will convince him of the truth of this. Illustrations have been deliberately omitted from this book to the end that the statements made herein may be illustrated by the student himself upon the living body.

Where classes are at all large it is not usually feasible for the department of anatomy to afford facilities (in the shape of living models and adequate time) for each student to study systematically the surface anatomy of the whole body, so that the main responsibility and burden fall upon the student himself. He will probably find that the most satisfactory method of studying the subject is to arrange

to foregather with two or three companions at a suitable place, and as often as may be necessary for the purpose, each in turn acting as a model. This book is intended to serve as a guide to such study. A knowledge of descriptive anatomy is assumed, and the student will do well to have beside him a well-illustrated text-book or an atlas of anatomy, and if possible the more important bones of the body, in order to facilitate the visualisation of the structures under consideration.

Surface anatomy is sometimes subdivided into (1) surface landmarks and (2) surface markings, the former term being applied to those structures which are visible or palpable from the surface, such as many bony points, while the latter term refers to artificial marks which are made upon the surface of the body to indicate the situation of underlying structures, many of which do not form landmarks—for example most nerves and viscera. While landmarks and markings are best studied together, the student should make a careful mental note of those structures which are normally visible or palpable and of those which are not, for clearly it is only upon a basis of this knowledge that a decision can be reached as to whether a given swelling or pulsation, for example, is normal or abnormal.

Furthermore, a knowledge of the structures which lie deep to a given region is essential for the correct diagnosis of many lesions. For example swellings occurring in regions where there are no lymph nodes, such as the top of the scalp or the fingers, cannot be swollen lymph nodes !

For the actual marking skin pencils or crayons are very useful. Water-colours may be used, but they possess the disadvantage of a liability to smudge

and run. If but a single colour be used, dark blue will be found very suitable, because it stands out so sharply against the skin. If several colours be used —and this is preferable — each colour should be reserved for structures belonging to the same category—for example red for arteries, green for nerves, and so forth. If the marks be allowed to remain on the skin the area under study will tend to become obscured by them. Before this point is reached an application of soap and water will leave the surface clean for further markings. It is sometimes desirable to have certain markings *in situ* while others are being drawn. In such circumstances the desired markings, if previously erased, may simply be re-drawn.

Bilateral structures should be marked in on both sides of the body.

For the sake of brevity only the most important muscles have been referred to in the following pages. In particular, accounts of the swellings caused by the bellies of the muscles have been omitted.

It will be understood that the measurements given require to be corrected in the case of children, the amount of correction necessary depending upon the size of the child.

The student must bear in mind that all anatomical description has reference to the body in the so-called *anatomical position—i.e.* standing erect, with the feet parallel, the arms by the sides and the palms looking forwards. For example, on page 105, in the description of the styloid process of the ulna, this point must be remembered in the interpretation of the word "ventral."

Students commonly fail to associate the facts of surface anatomy with those of ordinary descriptive anatomy, thus increasing their memorial burdens,

besides foregoing a piece of valuable training. Examples of such associations will be found in the following pages, and it is usually in this connection that it will be found advantageous to retain the markings of certain structures other than that under immediate consideration.

In this book numerous suggestions will be found, of which the following are examples :—(1) on page 91: "A comparison of the surface anatomy of the lung with that of the liver illustrates the fact that the upper portion of the liver is separated from the chest wall by lung"; (2) on page 83: ". . . the student should adduce facts which show that the area in question conforms to the three principles enunciated above." It is expected that the student will follow such suggestions conscientiously, thinking out what he should do, and carefully formulating definite answers to the problems involved.

This little book is not encyclopaedic, but it is intended to be thorough so far as it professes to go. Of vastly greater importance than this, however, is thoroughness on the part of the student. This does not imply that he should attempt to achieve the impossible in the way of memorising facts, but that what he does should be done well, as a matter of principle—nay, of honour. The medical man who does less than his best betrays the trust which the public places in the profession. The student—and the teacher too—may be reminded of the words of the late Professor Minot: "Our entering students rapidly classify themselves according to their loyalty to their immediate work. The best men already feel the gravity of their decision to become physicians; they appreciate the seriousness of their studies, and work faithfully each day with a prophetic instinct

that each day's knowledge builds up the base of their future decisions. They are already filled with a sense of responsibility; and to nourish that sense, to sustain the loyalty of the learners should be the constant goal of the medical teachers' ambition. The student should be made to feel *from the very start* that his purpose in life must be to serve, and that *devotion to his studies is his initiation into the life of perfect devotion to his patients.*"

ELEMENTS OF SURFACE ANATOMY

CHAPTER I

THE HEAD

The nasion is the depressed area at the junction between the nose and the forehead, overlying the fronto-nasal suture, which can usually be identified by palpation.

The **supra-orbital margin** should be gently palpated throughout its length.

The **supra-orbital notch** is felt in the neighbourhood of the junction between the medial and middle thirds of the supra-orbital margin. It is most easily identified by palpation from below.

Sometimes the notch is converted into a foramen, in which case it is palpable with difficulty, if at all, and this condition may be unilateral or bilateral.

The **supra-orbital nerve** and **vessels** emerge through the supra-orbital notch (or foramen) and run practically straight up over the forehead and anterior part of the scalp.

The **superciliary arch (ridge)** is the ridge felt im-

mediately superior to the supra-orbital margin. The eyebrow is set upon it.

The ridge varies in the degree of its development, but, although the underlying frontal air sinus varies likewise, it has been found that the two are independent, so that the prominence of the superciliary ridge is no indication of the size of the subjacent sinus.

The **frontal sinus** varies considerably in size, as above indicated. Only an X-ray examination or transillumination can reveal its actual size in any given individual, but what may be regarded as an average sinus would be represented on the surface by an approximately triangular figure the angles of which are situated at the following points :—

(1) the nasion,
(2) a point in the mid-line about $1\frac{1}{4}$ in. (3 cm.) superior to the nasion,
(3) a point immediately lateral to the supra-orbital notch.

The student may be reminded of the following facts :—

(*a*) the right and left frontal sinuses are rarely of equal size in the same individual ;
(*b*) the septum between the right and left sinuses is rarely situated entirely in the median plane ;
(*c*) the above surface marking fails to illustrate the fact that the sinus extends posteriorly for a varying distance within the orbital plate of the frontal bone.

The **infra-orbital margin** should be gently palpated

throughout its length and the absence of a notch noted.

The **infra-orbital foramen** may be felt as a slight depression about $\frac{1}{4}$ in. (0·6 cm.) below the centre of the infra-orbital margin. Even if it be not palpable its position should be marked.

The **infra-orbital nerve** and **vessels** emerge through the infra-orbital foramen and immediately divide into small radiating branches.

The position of the **mental foramen** is defined as follows :—If the supra-orbital notch and the infra-orbital foramen be joined by an imaginary line and that line be produced to cross the body of the mandible, the mental foramen is on (or near) the line about mid-way between the superior and inferior borders of the mandible—these borders are identified by palpation. The foramen may be palpable as a slight depression.

The **mental nerve** and **vessels** emerge through the mental foramen and immediately divide into small branches.

The **zygomatic (external angular) process of the frontal bone** is easily felt at the superior and lateral portion of the orbit.

The suture between it and the zygomatic (malar) bone can usually be identified by palpation.

The **temporal line** may be felt passing
superiorly from the zygomatic process of the frontal bone,
then *posteriorly* along the side of the head,
and finally *inferiorly* behind the ear;
so that it presents a general convexity upwards. Whereas its anterior portion constitutes a very distinct ridge, it becomes less distinct as it passes backwards. It is commonly less distinct in females than in males.

It indicates
(1) the lateral boundary of the scalp proper,
(2) the superior limit of (*a*) the temporal region,
(*b*) the temporal fascia,
(*c*) the temporal muscle.

The **zygomatic arch** or **zygoma** extends
from the prominence of the cheek horizontally backwards
to the superior extremity of the attachment of the auricle to the head.

Palpation reveals the fact that it is subcutaneous throughout. In emaciated individuals it appears unusually prominent.

The **auriculo-temporal nerve** and the **superficial temporal vessels** ascend superficial to the zygoma immediately anterior to the ear, and divide into branches which spread over the side of the head.

The superficial temporal artery is often seen, and can always be felt, pulsating where it crosses the zygoma. The pulse may be observed here during

anaesthesia, and the artery may easily be compressed against the zygoma for the temporary control of severe haemorrhage from a wound in the side of the scalp. For these reasons the student should palpate this artery in his companions until he can put his finger upon it unerringly. One of its branches is often seen, and can usually be felt, pulsating posterior and perhaps slightly superior to the zygomatic process of the frontal bone; this branch is of interest by virtue of the fact that the condition of arteriosclerosis is frequently to be observed therein.

At this point the student should review the four principal cutaneous branches of the trigeminal nerve of which he has been studying the surface anatomy —namely:

(1) the supra-orbital nerve,
(2) the infra-orbital nerve,
(3) the mental nerve,
(4) the auriculo-temporal nerve.

With reference to each of these nerves he should recall the following points:—

(*a*) the division of the trigeminal nerve from which it is derived;
(*b*) the point at which it becomes subcutaneous;
(*c*) the area of skin supplied by it.

These matters are of significance in connection with trigeminal neuralgia and with referred pain.

The **external occipital protuberance** is usually easy to identify by palpation, though occasionally, and especially in females, it may be very inconspicuous. It is often known as the inion.

The **superior nuchal (curved) line** can usually be

felt as a slight ridge extending laterally from the external occipital protuberance towards the mastoid process, with a slight convexity superiorly.

The **great occipital nerve** and the **occipital vessels** enter the scalp by crossing the superior nuchal line about mid-way between the external occipital protuberance and the base of the mastoid process, whence they run up over the back of the scalp.

Although the pulsations of the artery are usually difficult to feel, it may be compressed by the application of direct pressure against the superior nuchal line in the situation indicated.

From his study of their surface anatomy the student will observe that the arterial trunks supplying the scalp enter that region from below and run superiorly towards the vertex.

The **occipital lymph nodes** are situated on the trapezius at or just below its attachment to the superior nuchal line.

They drain the back of the scalp, and septic conditions in this region are a common cause of enlargement of these nodes.

The **mastoid process** is felt behind the lower part of the ear.

It is subcutaneous and contains mastoid air cells. Its position should be accurately noted, for suppuration in the mastoid air cells or antrum (acute mastoiditis) is frequently accompanied by signs of inflammation over the mastoid process.

The process and its contained air cells do not develop until the second year of life.

The **tympanic (mastoid) antrum** lies immediately superior and posterior to the external acoustic (auditory) meatus.

Its position should be marked with the auricle (pinna) drawn forwards.

In an infant it lies relatively slightly higher than in an adult.

Although an infant has no mastoid process or air cells, it may nevertheless suffer from mastoiditis, the inflammation involving the antrum.

The **posterior auricular (mastoid) lymph nodes** are situated on the sterno-mastoid muscle at or immediately inferior to its attachment to the mastoid process.

The presence and position of these nodes should be noted, for inflammation thereof must be distinguished from mastoiditis.

The **bregma** is the junction of the sagittal and coronal sutures. It is situated in (or near) the mid-line, about $1\frac{1}{2}$ in. (3·75 cm.) anterior to the mid-point between the nasion and the external occipital protuberance.

In an infant the region of the bregma is occupied by the **anterior fonticulus (fontanelle)**, a rhomboidal deficiency in the ossification of the cranial vault.

The student should avail himself of a suitable opportunity to palpate the anterior fontanelle in an

infant of less than a year old, as it closes normally during the second year of life. The utmost gentleness must be employed, together with such tact and discretion as the occasion may demand.

The fact of the anterior fontanelle being palpable or not, as the case may be, upon vaginal examination yields valuable information in obstetrical cases.

In young infants a gentle pulsation may be felt at the fontanelle. Moreover, it furnishes useful information concerning the intra-cranial tension, feeling tense and bulging when the tension is increased, as in meningitis and hydrocephalus, and being sunken and sub-normally tense when the intra-cranial tension is diminished, as in marasmus. Normally it becomes tense when the infant cries.

Since the superior sagittal (longitudinal) sinus lies immediately inferior to the fontanelle, intravenous work, such as the intravenous injection of drugs, in the case of young infants is sometimes done through the anterior fontanelle and the superior sagittal sinus, the subcutaneous veins, which are utilised for this purpose in adults, being frequently unsuitable by reason of their small size in infants.

Under pathological conditions the obliteration of the fontanelle may be hastened, as in microcephaly, or it may be retarded, as in rickets and hydrocephalus.

The **lambda** is the junction of the sagittal and lambdoid sutures. It is situated in (or near) the midline, about $2\frac{1}{2}$ in. (6·25 cm.) superior to the external occipital protuberance.

In an infant at birth the **posterior fonticulus (fontanelle)** is situated at the lambda. There is little actual

bony deficiency here however, palpation revealing merely the three sutures (sagittal and right and left lambdoid) radiating from the lambda.

It possesses an obstetrical significance akin to that of the anterior fontanelle.

The **pterion** is the region where the following bones come together :—

(1) frontal (posterior border of squama frontalis or vertical part),
(2) parietal (sphenoidal angle),
(3) temporal (squamous portion),
(4) sphenoid (great wing).

It is situated about $1\frac{1}{2}$ in. (3 cm.) posterior to the zygomatic process of the frontal bone, and a like distance superior to the zygomatic arch.

It is a region of great surgical importance.

The **sagittal suture** separates the two parietal bones, and therefore extends in the mid-line

from the bregma
to the lambda.

The **metopic suture** separates the two halves of the frontal bone, and is normally present only in children under the age of about six years, in whom it extends in the mid-line

from the bregma
to the nasion.

Occasionally it persists in adults, either in its entirety or in part ; in the latter case it is the inferior extremity of the suture which persists.

The **coronal suture** separates the frontal from the parietal bones, and therefore extends

from the pterion of one side
through the bregma
to the pterion of the opposite side.

The **lambdoid suture** separates the occipital from the parietal bones and extends

from the lambda
to the base of the mastoid process.

The **squamous suture** separates the parietal bone from the squamous temporal, and extends in a curve, convex superiorly,

from the pterion
to the base of the mastoid process,

the summit of the curve falling about $1\frac{1}{4}$ in. (3 cm.) inferior to the temporal line.

A knowledge of the surface anatomy of the principal sutures is of assistance in diagnosing between a fracture and a normal suture in the case of a head wound in which the bone is exposed. This is particularly true of a persistent metopic suture or part thereof. It is recorded that Hippocrates once mistook a normal suture for a fracture.

From the surface anatomy of the sutures it will be understood that, in an infant's head, whereas three sutures radiate from the posterior fontanelle (lambda) —viz.

(1) the sagittal suture,
(2) the right lambdoid suture,
(3) the left lambdoid suture,

four sutures radiate from the anterior fontanelle (bregma)—viz.

(1) the sagittal suture,
(2) the metopic suture,
(3) the right half of the coronal suture,
(4) the left half of the coronal suture.

This point is of assistance in the recognition of the fontanelles upon vaginal examination during labour, a matter of considerable significance.

The **superior sagittal (longitudinal) sinus** extends in the mid-line

from the nasion

to the external occipital protuberance.

The surface anatomy of this sinus illustrates the fact that it is related to (lies immediately deep to) both the fontanelle and the sagittal suture. The clinical significance of its relationship to the anterior fontanelle has been mentioned (page 22). Its relationship to the sagittal suture is of importance, because if the over-riding of the parietal bones at the sagittal suture which occurs during childbirth be for some reason excessive the underlying sinus may be injured, with the production of a haemorrhage which affects the cortical motor areas, usually for the lower limbs, producing a characteristic type of paralysis known as Little's Disease.

The **transverse (lateral) sinus** lies for the most part in the attached peripheral border of the tentorium cerebelli, and the greater part of it is represented upon the surface by a line extending, with a slight convexity superiorly,

from the external occipital protuberance
to the attachment of the auricle to the head at the level of the external acoustic meatus,
and *then* bending inferiorly for about ½ in. (1·25 cm.).

The surface marking of the terminal portion of the sinus is difficult and of little consequence.

The surface anatomy of the parts illustrates the fact that as it bends inferiorly the transverse sinus is intimately related to the mastoid antrum and air cells. Because of this relationship sepsis may spread from these cavities to involve the transverse sinus—in other words, septic thrombosis of the transverse sinus may occur as a complication of mastoiditis.

Since the peripheral border of the **tentorium cerebelli** is attached posteriorly to the margins of the groove for the transverse sinus on the occipital bone, it follows that the surface marking of the periphery of the posterior portion of the tentorium is identical with the marking of the horizontal portion of the transverse sinus.

Since the tentorium separates the occipital lobe, which lies superior to it, from the cerebellum, which lies inferior to it, it follows that the occipital lobe must lie deep to a surface area of the head situated superior to the line representing the periphery of the tentorium, while the cerebellum lies deep to a surface area of the head situated inferior to that line (see pages 29 and 30).

The **posterior ramus of the lateral fissure (of Sylvius)** is represented by a line drawn posteriorly and

slightly superiorly from the pterion for about 3 in. (7·5 cm.).

The **temporal (temporo-sphenoidal) lobe** of the brain lies deep to that portion of the side of the head comprised between the line representing the posterior ramus of the lateral fissure and the zygoma. The temporal pole extends a very short distance anterior to the pterion, while posteriorly the temporal lobe ends immediately posterior to the ear.

The surface anatomy of the temporal lobe shows that it lies immediately superior to the ear. In this connection the student should recall the fact that the temporal lobe and its meninges, lying in the middle cranial fossa, are immediately superior to the tympanic cavity and antrum. Because of this anatomical relationship meningitis and temporal lobe abscess sometimes complicate otitis media.

The **cortical centre for hearing**, being situated in the superior temporal gyrus, is therefore indicated on the surface immediately inferior to the middle of the line representing the posterior ramus of the lateral fissure.

The **central sulcus (fissure of Rolando)** is probably most satisfactorily marked on the surface by the following method. This can be done properly only upon a shaven head, but failing that the student should practise it so far as possible upon such heads as may be available. An alopecious acquaintance might be useful in this connection—were he amenable.

The method depends upon the fact that the central sulcus forms approximately three-quarters of a right

angle (67·5°) with the mid-line. The steps are as follows:—

(1) One of the angles of a rectangular piece of paper or gauze is folded evenly, thus reducing it to half a right angle (45°).

(2) It is again folded, thus reducing it to one-quarter of a right angle (22·5°).

(3) It is next unfolded, whereupon the original right angle is found to be subdivided into four angles of 22·5° each.

(4) One of these four small angles is folded over or removed, leaving three-quarters of a right angle (67·5°).

(5) The apex of this angle is placed at a point in the mid-line $\frac{1}{2}$ in. (1·25 cm.) posterior to the mid-point between the nasion and the external occipital protuberance, and one side of the angle is laid along the mid-line, extending anteriorly from the apex. The other side of the angle approximately overlies the central sulcus.

(6) The central sulcus may now be marked on the surface by a gently undulating line, about $3\frac{1}{2}$ in. (8·75 cm.) in length, extending inferiorly and anteriorly from the apex of the above angle along its lower side. It should end about 1 in. (2·5 cm.) posterior and superior to the pterion.

The surface anatomy of the central sulcus is of importance because it is used as a guide to the cortical motor area (anterior central gyrus).

The **frontal lobe** of the brain lies anterior to the line representing the central sulcus.

The **cortical motor area** is situated in the anterior central gyrus (ascending frontal convolution), immediately anterior to the central sulcus.

It is therefore represented on the surface by a strip parallel to the line representing the central sulcus, and in antero-posterior breadth extending anteriorly for $\frac{1}{2}$ in. (1·25 cm.) from that line. This $\frac{1}{2}$ in. (1·25 cm.) represents the width of the anterior central gyrus.

The **parietal lobe** of the brain lies posterior to the line representing the central sulcus and superior to that representing the posterior ramus of the lateral fissure, but it does not extend to the extreme posterior end of the head.

The **cortical area for common sensation** is situated in the posterior central gyrus (ascending parietal convolution), immediately posterior to the central sulcus.

It is therefore represented on the surface by a method similar to that of representing the cortical motor area, *mutatis mutandis*.

The **occipital lobe** of the brain lies deep to the extreme posterior end of the head, immediately superior to the line representing the transverse sinus and the periphery of the posterior portion of the tentorium cerebelli, for the lobe rests upon the tentorium.

The **cortical centre for vision**, being situated in the occipital lobe, has the same surface marking as that lobe.

The **cerebellum** lies deep to that portion of the back of the head inferior to the line representing the horizontal portion of the transverse sinus and the periphery of the posterior part of the tentorium cerebelli. The surface anatomy of the cerebellum illustrates its close relationship to the tympanic antrum and mastoid air cells. Because of this anatomical relationship cerebellar abscess is an occasional complication of mastoiditis.

The **middle meningeal artery** merits the most careful study, since it is very frequently ruptured in head injuries, necessitating an immediate operation.

I. The **main trunk** reaches the side-wall of the skull about the mid-point of the zygoma.

It may bifurcate there, or at any point up to ½ in. (1·25 cm.) above the mid-point of the zygoma.

II. The **anterior branch** runs from the point of bifurcation to the pterion.

In those cases in which the bifurcation occurs in relation to the base of the skull, the anterior branch usually reaches the side-wall of the skull a short distance inferior to the pterion.

From the pterion the anterior branch runs superiorly and posteriorly towards the mid-point between the nasion and the external occipital protuberance.

From its surface anatomy it will be observed that the anterior branch runs posterior and approximately parallel to the coronal suture, and therefore deep to the anterior part of the parietal bone.

It will be observed further that the vessel runs immediately anterior to the cortical motor area in the anterior central gyrus. Because of this anatomical relationship motor symptoms are characteristic of

haemorrhage from the anterior branch of the middle meningeal artery.

III. The **posterior branch** runs from the point of bifurcation posteriorly and slightly superiorly towards the lambda, passing about 1 in. (2·5 cm.) superior to the external acoustic meatus.

The **lacrimal gland** is situated in the superior and lateral corner of the orbit, under shelter of the zygomatic process of the frontal bone.

The normal gland cannot be felt.

The **medial palpebral ligament** (**tendo oculi**) may be felt at the medial corner of the eye when the latter is tightly closed or the eyelids are gently drawn laterally.

The **lacrimal sac** may be represented on the surface by a small ellipse

about $\frac{1}{2}$ in. (1·25 cm.) in *length*
and $\frac{1}{4}$ in. (0·6 cm.) in *breadth*,
with its *long axis* vertical,
its *lateral border* immediately medial to the medial palpebral commissure (canthus),
and its *centre* immediately inferior to the medial palpebral ligament.

It is not easy actually to mark in the lacrimal sac, and while attempting to do so the very greatest care must be exercised to avoid any accident.

The surface anatomy of the lacrimal sac conforms to the fact that the medial palpebral ligament lies superficial or anterior to the superior extremity of the sac. Because of this anatomical relationship

suppuration within the sac (dacryocystitis) commonly points inferior to the ligament, and should it be necessary to open the sac from the face the incision is kept inferior to the ligament, which is thus preserved.

The **naso-lacrimal duct** is represented on the surface by a line about $\frac{1}{2}$ in. (1·25 cm.) in length drawn

from the inferior extremity of the lacrimal sac

towards the first upper molar tooth.

The **head of the mandible** and its **joint** can be felt about $\frac{1}{4}$ in. (0·6 cm.) anterior to the ear-hole when the jaw is moved, especially if it be moved from side to side.

The **neck of the mandible** is immediately inferior to the head, but it can scarcely be felt.

It indicates the level of

(1) the facial nerve,

(2) the bifurcation of the external carotid artery.

The superficial aspect of the **body** and the **angle of the mandible** are easily felt, being to a considerable extent subcutaneous, although the lateral aspect of the angle is covered by the insertion of the masseter.

By pushing the skin and other soft parts before the fingers the inferior portion of the deep or medial aspect of the body and angle of the mandible may be palpated, the medial aspect of the angle, however, being covered by the insertion of the internal pterygoid.

The **masseter** can easily be felt contracting if the jaws be clenched.

Its **anterior border** should be defined by palpation. It indicates

(1) where the external maxillary (facial) artery crosses the mandible,

(2) where the parotid duct bends medially and pierces the buccinator.

The **parotid gland** is very variable in size and shape. It is situated within a region bounded approximately as follows :—

superiorly, by the zygoma ;

posteriorly, by (1) the external acoustic meatus,
(2) the mastoid process ;

inferiorly, by (1) a line from the tip of the mastoid process to the angle of the mandible,
(2) a small posterior portion of the inferior border of the mandible ;

anteriorly, by a vertical line from the inferior border of the mandible to the zygoma, some little distance (variable) posterior to the anterior border of the masseter.

The **parotid (Stensen's) duct** lies deep to the middle third of a line

from the lobule of the ear

to mid-way between the ala of the nose and the red margin of the upper lip.

It is liable to injury in wounds of the face, and its precise situation should be borne in mind so that it may be avoided when planning incisions into the side of the face.

The **accessory parotid gland** (**socia parotidis**), when present, usually lies immediately superior to the posterior extremity of the parotid duct.

If inflamed it may give rise to a discrete swelling in this situation.

The **anterior auricular** (**parotid**) **lymph nodes** lie in relation to the parotid gland.

The presence and situation of these nodes should be borne in mind in order that affections thereof may not be mistaken for affections of the parotid gland.

The **main trunk of the facial nerve** crosses the neck of the mandible about the level of the superior extremity of the lobule of the ear.

Its principal branches (or groups of branches) arise within the parotid gland, radiate from its anterior border and proceed as follows :—

(1) the **temporal**, across the zygoma to the temporal and supra-orbital regions ;
(2) the **zygomatic**, inferior to the zygoma to the infra-orbital region ;
(3) the **buccal**, inferior to the parotid duct to the mouth region ;
(4) the **mandibular**, superior to the inferior margin of the mandible to the chin region ;

(5) the **cervical**, anteriorly immediately inferior to the mandible.

A knowledge of the position of these branches is of importance, since it is highly advantageous to preserve them if possible in operative procedures upon the face. They may be divided in wounds of the face.

The **palatine** or **faucial tonsil** varies considerably in size, but what might be considered an average tonsil may be represented upon the surface by an ellipse

about 1 in. (2·5 cm.) in *length*
and $\frac{1}{2}$ in. (1·25 cm.) in *breadth*,
with its *long axis* vertical,
and its *centre* about $\frac{1}{2}$ in. (1·25 cm.) anterior and superior to the angle of the mandible.

The surface marking of the tonsil illustrates the fact that it lies medial to the inferior extremity of the ramus of the mandible, separated from it however by the superior constrictor of the pharynx and the internal pterygoid. Because of this relationship to the mandible direct pressure for the control of haemorrhage after tonsillectomy should be made in a lateral direction, thus compressing the tonsillar bed with its vessels against the mandible.

A normal tonsil is not palpable from the exterior, and even in many cases of tonsillitis the swellings palpable in the region of the angle of the mandible are not the tonsils but enlarged lymph nodes.

The **external maxillary (facial) artery** is marked upon the surface as follows:—From a point immediately posterior to the tip of the great horn of the hyoid bone (see page 41) a line is drawn superiorly to a point

about $\frac{1}{2}$ in. (1·25 cm.) anterior and superior to the angle of the mandible, where it bends inferiorly and anteriorly to the inferior border of the mandible at the anterior border of the masseter. From this point it is continued superiorly and anteriorly in a tortuous fashion, passing about $\frac{1}{2}$ in. (1·25 cm.) from the corner of the mouth, to the side of the root of the nose immediately medial to the lacrimal sac. The portion of the artery related to the nose is termed the **angular artery.**

The surface marking of the artery illustrates the fact that its loop lies lateral to the tonsil, the superior constrictor of the pharynx intervening. On this account it may be injured during tonsillectomy. It may be compressed where it crosses the mandible for the control of haemorrhage from a wound of the face, and the pulse may be observed there during anaesthesia. Since the angular artery lies medial to the lacrimal sac, an incision into the latter should be made lateral to the line of the artery.

The **maxillary sinus** (**antrum of Highmore**) varies considerably in size and only special methods of examination can reveal its actual size in a given individual.

What may be regarded as a typical sinus would be represented on the surface by a roughly triangular figure the angles of which are situated at the following points :—

(1) the medial extremity of the infra-orbital margin,

(2) the skin over the alveolar process of the maxilla opposite the second upper molar tooth,

(3) the centre of the prominence of the cheek, immediately inferior to the lateral margin of the orbit.

Their surface markings will remind the student of the important relationship between the infra-orbital nerve and the maxillary sinus.

CHAPTER II

THE NECK

The spine of the 2nd cervical vertebra or **epistropheus (axis)** is the first bony point felt below the external occipital protuberance in the mid-line, for it will be recalled that the first cervical vertebra or atlas has no spine but a small posterior tubercle.

The **spines of the 3rd, 4th and 5th cervical vertebrae** can be felt in line below that of the 2nd, but it may not be easy to identify them individually since they lie at some considerable depth from the surface, from which they are separated by the ligamentum nuchae.

The **spines of the 6th and 7th cervical vertebrae** are easily felt. That of the 7th is the more prominent, for which reason this vertebra is frequently known as the **vertebra prominens.**

The **transverse process of the atlas** is felt upon deep palpation between the mastoid process and the angle of the jaw.

The **carotid tubercle** (of Chassaignac) is the anterior tubercle of the transverse process of the 6th cervical vertebra. It may or may not be large enough to be palpable, but in any case it is situated at the level of

the cricoid cartilage which is a prominent landmark (see page 42).

The common carotid artery lies anterior to it, and in an emergency might be compressed by backward pressure against the tubercle.

The **superior border of the sternum**—see page 56.

The **clavicle** is practically subcutaneous throughout its length, and is therefore readily examined by palpation. Its curves and general conformation should be observed.

Either or both extremities of the clavicle may be very prominent, and this condition when present is usually bilateral. The latter point may be of some assistance in deciding whether such prominence is normal (to the individual in question) or abnormal, bilaterality generally favouring the view that it is normal.

The **acromio-clavicular joint** is situated immediately lateral to the antero-posterior ridge which indicates the lateral extremity of the clavicle.

If no such ridge be present, it may yet be possible to identify the joint by feeling a slight gap between the acromion and the clavicle, especially if an attempt be made to insert the finger-nail between them. Such a gap is to be sought about two finger-breadths—say $1\frac{1}{2}$ in. (3·75 cm.)—medial to the lateral border of the acromion (see page 100).

If the joint cannot be identified by either of the above methods, its position may be marked upon the surface by an antero-posterior line drawn about

$1\frac{1}{2}$ in. (3·75 cm.) medial to the lateral border of the acromion, as above indicated.

The **sterno-clavicular joint** is indicated by a line
about $\frac{1}{2}$ in. (1·25 cm.) in length,
sloping from above downwards and laterally,
slightly convex infero-medially,
and situated immediately infero-medial to the sternal end of the clavicle.

The **supra-clavicular fossa** is the region immediately superior to the middle of the clavicle, between the posterior border of the sterno-mastoid and the anterior border of the trapezius.

It corresponds roughly to the subclavian triangle (see page 46).

The most important structures lying deep to this fossa (and therefore within the subclavian triangle) are:

(1) the third portion of the subclavian artery,
(2) the supra-clavicular lymph nodes,
(3) the cervical portion of the brachial plexus.

The apex of the lung lies immediately postero-medial to the fossa, the degree of prominence of which may therefore be of pathological significance—for example, extreme indrawing occurs in some cases of phthisis, whereas there is often undue prominence in emphysema, especially when the patient coughs.

The student should observe the elasticity of the skin over the supra-clavicular fossa and the clavicle—how easily it can be pinched up and moved about. This fact is utilised in the operation of ligation of the third portion of the subclavian artery, it being a common practice to draw the skin of the supra-clavicular fossa down over the clavicle, incise it, and

then allow it to return, when the incision comes to lie in the fossa—*i.e.* over the artery.

The **body of the hyoid bone** is the first resistant structure met with in the mid-line below the chin. It is best felt with the head thrown well back.

The **great horn of the hyoid bone** can be felt extending laterally, posteriorly and slightly superiorly from the body of the bone.

Its tip should be identified, as it is the landmark for the origin of certain branches of the external carotid artery (see page 35). It is usually felt immediately in front of the anterior border of the sterno-mastoid. The tip of the great horn may be rendered more prominent, and its identification by palpation facilitated, by the exercise of very gentle pressure in a medial direction upon the great horn of the opposite side.

The **laminae of the thyreoid cartilage** are felt on either side of the mid-line, inferior to the hyoid bone.

The **superior border** of the lamina of the thyreoid cartilage is the landmark for the bifurcation of the common carotid artery.

The **laryngeal prominence (Adam's apple)** is the union in the mid-line of the superior borders of the two laminae of the thyreoid cartilage. It is the most prominent part of the thyreoid cartilage.

As is well known, it is more prominent in men than in women and children, and in certain individuals than in others.

The **thyreo-hyoid membrane** extends between the superior border of the thyreoid cartilage and the hyoid bone.

It is sometimes injured in cut-throat wounds.

The **anterior border of the thyreoid cartilage** is felt in the mid-line extending inferiorly for a short distance from the laryngeal prominence.

The **vocal folds** (**true vocal cords**) are attached anteriorly to the middle of the posterior aspect of the anterior border of the thyreoid cartilage.

The **cricoid cartilage** is easily felt below the thyreoid cartilage.

It indicates the level of

(1) the carotid tubercle of the 6th cervical vertebra (see page 38);

(2) the crossing of the carotid sheath by the omo-hyoid muscle (see pages 46 and 52);

(3) the commencement of the trachea and of the oesophagus.

It is an important landmark in the operation of tracheotomy.

The **crico-thyreoid ligament** occupies the space between the cricoid and thyreoid cartilages.

This membrane is divided in the operation of laryngotomy. The surface anatomy illustrates the relationship of the vocal folds to the field of this operation.

The student will recall that the **trachea** begins at the inferior extremity of the larynx and ends by

dividing in the mid-line into right and left bronchi posterior to the sternal angle.

From this it follows that from the point of view of surface anatomy it is described as extending in the mid-line

from the inferior border of the cricoid cartilage
to the sternal angle (see page 57).

Some of the rings of the trachea may be palpable in the inferior part of the neck, but immediately inferior to the cricoid cartilage they are rendered impalpable by the superjacent isthmus of the thyreoid gland (see page 44).

In the operation of high tracheotomy the trachea is opened by dividing its upper three rings (or thereby) above the isthmus of the thyreoid gland, between it and the cricoid cartilage, if necessary the isthmus being pulled down gently to give more room. In the operation of low tracheotomy the trachea is opened below the isthmus of the thyreoid gland.

The **oesophagus**, it will be remembered, commences at the inferior extremity of the pharynx, posterior to the inferior border of the cricoid cartilage, and extends to its opening into the stomach, which is situated posterior to the 7th left costal cartilage, one inch from the mid-line, at the level of the 10th or 11th thoracic vertebra.

Bearing in mind that the cricoid cartilage is at the level of the 6th cervical vertebra, it will be understood from the foregoing that the oesophagus is represented upon the surface as follows :—

A. On the ANTERIOR aspect of the body, by a line
from the inferior border of the cricoid cartilage in the mid-line

to the 7th left costal cartilage (see page 57) 1 in. (2·5 cm.) from the mid-line;

B. On the **posterior** aspect of the body, by a line
from the 6th cervical spine in the mid-line
to a point 1 in. (2·5 cm.) to the left of the 10th thoracic spine (see page 64).

The surface marking of the oesophagus on the back is of importance because in oesophageal affections information as to the condition is sometimes obtained by auscultating over the oesophagus while the patient swallows, and, since the oesophagus, in the thorax at any rate, is very much nearer the back than the front, it is best auscultated from behind.

The **thyreoid gland** varies greatly in size and shape, and the following account refers to what might be regarded as an average gland:—

I. The **isthmus** lies immediately inferior to the cricoid cartilage, and measures approximately 1 in. (2·5 cm.) vertically and from side to side—*i.e.* it extends for about $\frac{1}{2}$ in. (1·25 cm.) on either side of the mid-line.

II. Each **lateral lobe** is represented on the surface by a pyriform figure with
its *apex* at the middle of the lamina of the thyreoid cartilage,
its *base* immediately above the clavicle,
its *medial border* at the lateral extremity of the isthmus,
and its *lateral border* about $\frac{3}{4}$ in. (2 cm.) lateral to its medial border, where the two borders are farthest apart.

A perfectly normal thyreoid gland is neither visible nor distinctly palpable, except in some females during menstruation or pregnancy.

The **sterno-mastoid** is best studied with the head turned to the opposite side. It may be so prominent that it is obvious that it extends

from the mastoid process and the lateral extremity of the superior nuchal line

to the sternal end of the clavicle and the lateral portion of the superior end of the sternum.

If it is not prominent it may be indicated by two parallel lines, about $1\frac{1}{2}$ in. (3·75 cm.) apart, extending between the above points and diverging at either extremity, especially inferiorly.

A slight depression is usually visible between the sternal and the clavicular attachments of the muscle, and posterior to this depression is the inferior end of the internal jugular vein, and here the venous pulse is sometimes examined.

The slightly depressed area between the inferior ends of the two sterno-mastoid muscles is known as the **supra-sternal fossa**, and here the rings of the trachea may be palpable.

Since the **trapezius** arises in part from the medial third of the superior nuchal line and is inserted in part into the lateral third of the clavicle, it follows that its **anterior border** is represented on the surface by a line drawn

from the junction of the medial and middle thirds of the superior nuchal line

to the junction of the lateral and middle thirds of the clavicle.

The **omo-hyoid** is represented as follows:—

I. The **posterior belly** is indicated by a broad line
from a point a little behind the anterior border of the trapezius, just above the clavicle,
to the sterno-mastoid, opposite the cricoid cartilage.

II. The **anterior belly** is indicated by a broad line
from the sterno-mastoid, opposite the cricoid cartilage,
to the body of the hyoid bone, about $\frac{1}{2}$ in. (1·25 cm.) from the mid-line.

The surface marking of the omo-hyoid recalls the fact that it crosses anterior to the carotid sheath at the level of the cricoid cartilage.

The surface marking of the **digastric** is easily inferred from its attachments.

I. The **posterior belly** is represented by a broad line
from the mastoid process
to the body of the hyoid bone, about 1 in. (2·5 cm.) from the mid-line.

II. The **anterior belly** is represented by a broad line drawn
from the body of the hyoid bone, about 1 in. (2·5 cm.) from the mid-line,
to the inferior border of the chin, lateral to the mid-line.

The student will observe that after marking the position of the above muscles he is in a position to study the surface anatomy of the various **triangles of the neck**, all that is necessary being to recall the boundaries of the various triangles and the surface

markings of these boundaries. He may be reminded that the triangles of the neck are as follows :—

I. Anterior triangle
1. Submental triangle.
2. Submaxillary triangle.
3. Carotid triangle.
4. Muscular triangle.

II. Posterior triangle
5. Subclavian triangle.
6. Occipital triangle.

In view of their great surgical importance the student should practise marking the triangles individually, at the same time refreshing his visual memory as to the more important contents of each.

The **cervical pleura** and the **apex of the lung** are represented by a line

from the sterno-clavicular joint,
superiorly and slightly laterally
for about 1 in. (2·5 cm.),
well rounded off,
and then sloped inferiorly and laterally
to the junction of the middle and medial thirds of the clavicle.

The student should bear in mind the following facts :

(1) The apex of the lung and the cervical pleura are co-extensive—*cf.* their inferior margins (page 70).

(2) The height to which they rise varies from $\frac{1}{2}$ in. to $1\frac{1}{2}$ in. (1·25 cm. to 3·75 cm.) above the clavicle.

(3) Since this region of the lung is very frequently attacked by tuberculosis, careful examination thereof and to that end an accurate knowledge of its surface anatomy are highly important.

(4) The above surface marking illustrates the fact that the medial third of the clavicle has lung posterior to it. Upon this anatomical relationship depends the fact that normally a resonant note is obtained upon percussing the clavicle, particularly towards its medial end.

(5) It will be recalled that the cervical pleura and the apex of the lung rise to the level of the neck of the first rib, so that they are protected posteriorly by the ribs. But owing to the slope of the first rib they are unprotected by ribs laterally and anteriorly, as the surface marking shows, though a certain degree of protection is afforded by the clavicle, also by the scalene muscles, the sterno-mastoid and the infra-hyoid muscles.

The student will recall that the **right subclavian artery** commences posterior to the corresponding sterno-clavicular joint, curves superiorly, laterally, and then inferiorly, and terminates at the lateral border of the first rib; and that the **cervical portion of the left subclavian artery** pursues a similar course.

Bearing this in mind, it will be readily understood that each of these arteries is indicated on the surface by a curved line, convex superiorly,

from the sterno-clavicular joint

to the middle of the clavicle,

the summit of the curve rising about $\frac{3}{4}$ in. (2 cm.) above the clavicle.

A comparison of this surface marking with that of the apex of the lung and the cervical pleura illustrates

the fact that the subclavian artery crosses anterior to these structures below their summit. If this relationship be not borne in mind the pleura may be injured during ligation of the subclavian artery.

If the manner of subdivision of the subclavian artery and the relationship of the scalenus anterior to the sterno-mastoid be recalled, the surface anatomy will also be found to illustrate the fact that whereas the first and second portions of the subclavian artery lie deeply beneath muscles and are therefore inaccessible for the purpose of ligation, the third portion is situated in the anterior or medial part of the posterior triangle, and so, having no muscle anterior to it (except the negligible platysma), is accessible for ligation.

If the thumb be pressed down behind the clavicle (invaginating the skin) the artery may be felt pulsating, and if necessary the greater part of the blood supply to the upper limb may be controlled by compressing the artery downwards against the first rib.

The **supra-clavicular lymph nodes** are related to the veins lying posterior and superior to the clavicle—especially its medial half.

Since for the most part the axillary nodes drain into the supra-clavicular nodes, therefore the structures drained by the former group are drained also by the latter group.

Very briefly these structures are: (1) the upper limb and (2) the mammary gland. Therefore the most outstandingly important conditions causing enlargement of these nodes are (*a*) infections of the upper limb and (*b*) cancer of the breast.

When marking the **carotid sheath** and **its contents** the following facts should be recalled:—

(1) The internal jugular vein and the vagus nerve are contained throughout the whole length of the sheath, from the base of the skull to the root of the neck.

(2) The superior cervical sympathetic ganglion lies near the angle of the mandible, and from it the cervical sympathetic trunk (cord) extends down as far as the root of the neck.

(3) The entire right common carotid artery and the cervical portion of the left common carotid artery commence posterior to the corresponding sterno-clavicular joint and terminate by bifurcating at the level of the superior border of the thyreoid cartilage.

(4) The internal carotid artery arises from the common carotid opposite the superior border of the thyreoid cartilage and runs up to the base of the skull, which it enters through the carotid canal.

(5) The external carotid artery arises from the common carotid opposite the superior border of the thyreoid cartilage and terminates by bifurcating posterior to the neck of the mandible.

To mark in the carotid sheath and its contents the head of the model or patient is turned to one side, and on the opposite side a line is drawn

from the sterno-clavicular joint

to the mid-point between the tip of the mastoid process and the angle of the mandible.

From the latter point the line is prolonged superiorly

to a point immediately posterior to the neck of the mandible (see page 32).

A. The **whole length** of this line represents

(1) the internal jugular vein,

(2) the vagus nerve.

B. **Up to the level of the angle of the mandible** the line represents the cervical sympathetic trunk (cord).

C. **Up to the level of the superior border of the thyreoid cartilage** the line represents the common carotid artery.

D. **Above the level of the superior border of the thyreoid cartilage** the line represents

(1) the internal carotid artery,

(2) the external carotid artery.

The inaccuracy of utilising a single line for marking so many structures is obvious, but this may be overcome in the marking of any one of them by slightly modifying the position of the line in conformity with the relationships which these structures bear to one another. For example, since the internal jugular vein lies lateral to the carotid arteries inferiorly and dorsal to them superiorly, a line representing the vein would bear a corresponding relationship to one representing the arteries.

The virtue of the above method of marking these structures lies in its simplicity and the consequent ease with which it can be remembered, while its slight inaccuracy can be overcome by the method above indicated.

The carotid arteries may usually be felt, and can sometimes be seen, pulsating, and, as pointed out on page 39, the common carotid artery may be compressed against the carotid tubercle by pressure in a dorsal direction applied in the line of the vessel at the level of the cricoid cartilage.

The **deep cervical chain of lymph nodes** extends along the whole length of the internal jugular vein, along the line of which palpation is therefore to be carried out when examining for enlarged members of this group.

Some of them may project from beneath the anterior border of the sterno-mastoid into the anterior triangle, others from beneath its posterior border into the posterior triangle.

This chain is divided into

(1) the superior deep cervical nodes,

(2) the inferior deep cervical nodes,

the point of division between the two groups being placed more or less arbitrarily at the crossing of the carotid sheath (and of the deep cervical chain of lymph nodes) by the omo-hyoid, opposite the cricoid cartilage.

The superior deep cervical nodes are of especial clinical importance because amongst other things they drain, either directly or indirectly,

(1) the lymphoid tissue in the pharynx (tonsils),

(2) the tongue and lips.

Therefore (*a*) they are the first nodes to be affected in tuberculosis of the cervical lymph nodes (the pharyngeal lymphoid tissue being a common portal of entry for the organisms into the system); (*b*) further, these nodes become involved in cancer of the tongue and lips which has progressed beyond the very early stage.

The (**spinal**) **accessory nerve** is represented on the surface by a line drawn

from a point just posterior to the neck of the mandible

to the mid-point between the tip of the mastoid process and the angle of the mandible,

thence to a point on the anterior border of the sterno-mastoid about one quarter of the distance from the tip of the mastoid process to the superior border of the sternum,

next across the sterno-mastoid to the junction of the superior and middle thirds of its posterior border, and

finally across the posterior triangle to the junction of the middle and inferior thirds of the anterior border of the trapezius, and slightly beyond that point.

It will be observed that the superior portion of this line is practically identical with the superior portion of the line indicating the carotid sheath and its contents. That this should be so will be appreciated if the anatomical relationship of the accessory nerve to the vagus and the internal jugular vein be recalled.

If the transverse process of the atlas be palpated (see page 38) it will be seen from its surface marking that the accessory nerve is closely related to that process, so that the process is sometimes used as a guide to the nerve in the anterior triangle.

From its surface marking it will also be easy to recall visually the important relationships of the accessory nerve to

(1) the internal jugular vein,
(2) the superior deep cervical lymph nodes,
(3) the digastric,
(4) the sterno-mastoid.

Its relationship to the lymph nodes is of especial surgical importance, for during excision of these nodes care must be exercised that the accessory nerve be not injured.

The **external jugular vein** is commonly visible. It usually runs downwards, crossing superficial to the sterno-mastoid obliquely from its anterior to its posterior border,

from a point posterior to the angle of the mandible —where it is formed by the union of the posterior branch of the posterior facial (temporo-maxillary) vein with the posterior auricular vein—

to a point above the clavicle posterior to the inferior end of the sterno-mastoid—where it pierces the deep fascia roofing the posterior triangle and terminates by joining the subclavian vein.

The **superficial cervical (external jugular) lymph nodes** lie along the external jugular vein on the superficial aspect of the sterno-mastoid muscle.

They are not always present, but it may be well to be aware of their occasional existence and their situation in order that swelling thereof may be correctly diagnosed.

The **submaxillary salivary gland** is situated in the submaxillary triangle and extends upwards for a short distance deep to the mandible. The normal gland can scarcely be identified by palpation.

The **submaxillary lymph nodes** are related to the submaxillary salivary gland.

Amongst other things they drain the tongue and the

lips, therefore they are commonly enlarged in cancer of these parts.

They drain the teeth also, therefore dental conditions—affecting the upper teeth as well as the lower teeth—should not be forgotten as possible causes of swelling of these nodes.

The **anterior jugular vein** runs downwards about $\frac{1}{2}$ in. (1·25 cm.) from the mid-line,

from just below the chin

to the anterior border of the sterno-mastoid above the sternal end of the clavicle,

then laterally to the inferior end of the external jugular vein.

Marking the course of this vein on the surface recalls the fact that its terminal portion runs laterally deep to the sterno-mastoid muscle to terminate in the inferior end of the external jugular vein in the posterior triangle.

These veins are of some practical importance inasmuch as they may be the source of a certain amount of haemorrhage in the performance of the operation of tracheotomy (see page 43), being (like other veins) engorged in asphyxia, which is present when that operation is necessitated.

The **submental lymph nodes** are situated in the submental triangle.

Although a small group, they are of great clinical importance, for since they drain the tip of the tongue and the lower lip they are the first lymph nodes to be involved in cancer affecting those parts.

CHAPTER III

THE TRUNK

The clavicle—see page 39.

The **infra-clavicular** (Morenheim's) **fossa** is the area (commonly slightly depressed) immediately below the clavicle.

Its degree of prominence varies considerably, marked retraction occurring in certain cases of phthisis.

One or two **superficial infra-clavicular lymph nodes** may lie deep to this depression.

The **tip of the coracoid process of the scapula** is felt upon deep palpation in the infra-clavicular fossa, about 1 in. (2·5 cm.) inferior to the junction of the lateral and middle thirds of the clavicle. It is not subcutaneous, being covered by the anterior border of the deltoid.

The student should acquire thorough familiarity with this landmark, as it is of great importance in dislocations of the shoulder joint.

The **superior border of the sternum** is easily felt as a smooth border, concave superiorly, between the medial extremities of the two clavicles.

The **manubrium** and **body of the sternum** are subcutaneous throughout, and are easily palpable at the bottom of the sternal furrow, a vertical groove between the two pectoralis major muscles, the depth of the groove depending upon the degree of development of these muscles in the male, and of the mammae in the female.

The **sternal angle (of Ludwig or Louis)** is felt as a horizontal ridge at the junction of the manubrium and body of the sternum.

Since fat does not accumulate anterior to the sternum, this ridge is usually visible, and is almost invariably easily palpable.

It is situated at the level of the 2nd sterno-costal articulation, and is an important landmark in connection with the identification of ribs (*vide infra*).

The **thymus gland** lies posterior to the manubrium sterni. It is very irregular in size and shape, but the student should note that typically it is situated in the superior mediastinum of the thorax, though occasionally, especially in children, it may extend into the root of the neck.

The **ribs** and **costal cartilages** are best identified by counting (by palpation) from the 2nd, which may be readily identified from the fact that it is opposite the sternal angle.

As the accurate identification of ribs is of considerable importance the student should practise the identification of each rib by this method.

The **main trunks of the intercostal vessels** and **nerves** run in grooves deep to the inferior borders of the ribs.

In order to avoid injuring these vessels when tapping the chest the needle is introduced through the inferior portion of an intercostal space.

The **costal margin** is palpable with ease, extending inferiorly and laterally from the sternum.

The highest portion of the costal margin (that portion adjoining the sternum) is usually, though not invariably, formed by the 7th costal cartilage. The lowest portion of the costal margin when looked at from the front is usually formed by the 10th costal cartilage.

The **last two ribs** may be felt postero-laterally, but sometimes they are so rudimentary (especially the 12th) as not to project beyond the lateral border of the sacro-spinalis (erector spinae) muscle, under which circumstances they are not palpable. Occasionally a **13th rib** is present.

The degree of prominence of the costal margin varies and should be studied. It is reduced in all conditions which produce protuberance of the upper portion of the abdomen, such as ascites; and it is increased (1) when the abdomen is retracted, as in emaciation or severe dysentery, or (2) when the chest is rendered unduly prominent, as in emphysema.

The **sub-costal (or infra-costal) angle** is the angle, open inferiorly, formed by the right and left costal margins. The truncated apex of the angle is at the xiphi-sternal joint (*vide infra*).

The angle varies in size and its variations are of some significance.

The **infra-sternal fossa** (**pit of the stomach**) is the depressed area between the two costal margins, especially between their upper portions—*i.e.* it is the area included within the sub-costal angle. Certain abnormal pulsations are sometimes felt here.

The **xiphi-sternal joint** is felt as a transverse ridge at the superior end of the infra-sternal fossa.

The **xiphoid process** (**ensiform cartilage**) of the sternum can be felt extending inferiorly for a varying distance from the xiphi-sternal joint, lying at the bottom of the infra-sternal fossa.

It will be observed that the xiphoid process appears to occupy a plane posterior to that of the body and manubrium. This appearance is easily understood if the anatomy of the bone be recalled. The xiphoid process is considerably thinner antero-posteriorly than the remainder of the bone, and, since the posterior aspects of all the parts of the sternum are on a level, it follows that the anterior aspect of the xiphoid process must be in a plane posterior to that of the anterior aspect of the rest of the bone.

It will be recalled that the glandular portion of the **female mamma** consists of two main subdivisions:

(1) the body of the gland, or corpus mammae,

(2) a number of peripheral processes.

I. The **corpus mammae** is represented upon the surface by an approximately circular figure, extending

(*a*) vertically { from the 2nd rib / to the 6th costal cartilage,

(*b*) horizontally { from the 4th sterno-costal joint / to the 5th rib in the mid-axillary line.

II. The **peripheral processes,** radiating into the para-mammary fat, extend the limits of the mammary tissue considerably beyond those stated above for the corpus mammae. The largest of them, known as the AXILLARY TAIL of Spence, extends superiorly and laterally towards the axilla. These peripheral processes are of importance in connection with cancer of the breast.

In males and immature females the NIPPLE is usually situated over the 4th intercostal space, in or near the mid-clavicular line. (For an account of these lines see page 69.) In mature females, however, the nipple is variable in its surface relationships and is therefore of little utility as a landmark.

Accounts of the very important surface appearances of the mammae and of their physiological modifications will be found in the text-books of anatomy and obstetrics, to which the student should refer, but the following facts are of such importance in connection with the diagnosis of cancer of the breast that they may be mentioned here:—

(1) The nipple and the skin covering the mamma are not normally retracted or puckered and immovably fixed.

(2) The organ as a whole is movable upon the subjacent muscles. When testing this point the arm should be abducted in order to render taut the pectoralis major.

The **symphysis pubis** is felt as a firm resistance in the mid-line at the inferior extremity of the anterior abdominal wall. The fat which covers it may make it a little difficult to identify.

The **pubic crest** is felt extending laterally from the symphysis for about 1 in. (2·5 cm.) and terminating at the pubic tubercle.

The **pubic tubercle** (**spine**) is felt at the lateral extremity of the pubic crest, about 1 in. (2·5 cm.) from the symphysis.

As it is an extremely important landmark in cases of hernia, and further, as in certain cases its identification may present some little difficulty, the following methods of finding the tubercle may prove useful.

The **first method**, which is applicable to either sex, is based upon the fact that the adductor longus arises by a rounded tendon just below the pubic tubercle. If the thigh be abducted somewhat the adductors become tense, and the tendon of origin of the adductor longus is then very easily felt, and may be followed upwards to just below the pubic tubercle, which is then readily identified.

In the **second method**, which is applicable to the male only, the lateral portion of the scrotum is gently invaginated with the tip of the finger, which is gently passed upwards, lateral to the base of the penis, the pubic tubercle being then easily felt. For this manipulation the middle finger will be found most convenient if the patient be an adult, the little finger if he be a child.

The **anterior superior spine of the ilium** is easily felt and is usually easily seen.

It is sometimes desired to ascertain WHETHER OR NOT THE PELVIS BE TILTED TO ONE SIDE. This is done by drawing a line from one anterior superior iliac spine to cross the mid-line at right angles. Normally this line produced passes over (or very near) the other anterior superior iliac spine, but this is not the case if the pelvis be tilted. The student should think out how, in a case in which the pelvis was tilted, he would ascertain the direction of the tilt.

The **crest of the ilium** is easily felt extending posteriorly from the anterior superior iliac spine.

About $2\frac{1}{2}$ in. (6·25 cm.) behind that spine it usually presents a palpable TUBERCLE.

The vertical extent of the INTERVAL BETWEEN THE HIGHEST POINT OF THE ILIAC CREST AND THE LOWEST POINT OF THE COSTAL MARGIN should be observed. This varies somewhat in different individuals and in different positions, and its extent may be of some significance in certain operations, especially those upon the kidney and ureter.

The HIGHEST POINT OF THE ILIAC CREST seen from behind is opposite the 4th lumbar spine. This should be carefully remembered as it is the important landmark in the operation of lumbar puncture (see page 66).

The **posterior superior spine of the ilium** is situated at the posterior extremity of the iliac crest. It may be a little difficult to identify by palpation, but its position may always be ascertained from the

circumstance that it lies at the bottom of a slight but remarkably constant dimple or depression in the skin, about $1\frac{1}{2}$ in. (3·75 cm.) lateral to the mid-line.

It is opposite (1) the 2nd sacral spine,
(2) the middle of the sacro-iliac joint.

The **spine of the scapula**, being subcutaneous throughout, is easily felt extending from the acromion process, medially and slightly inferiorly, to its medial extremity or root, which is opposite the 3rd thoracic spine when the arm is by the side.

The **vertebral border of the scapula** is palpable below the root of the spine. It may sometimes be felt, and even seen, throughout its whole length.

It is unduly prominent under certain circumstances, for example (1) in the phthinoid type of chest and (2) when the serratus anterior (magnus) is paralysed. Consideration of the action of the serratus will reveal why this should be so.

The **inferior angle of the scapula** is easily felt and is usually easily seen, and it may be grasped from side to side. This is done in order to immobilise the scapula when testing the movements of the shoulder joint, since otherwise the mobility of the shoulder girdle might mask limitation of movement of the shoulder joint (*cf.* page 100).

When the arm is by the side the inferior angle of the scapula is opposite the 7th thoracic spine and overlies

the 7th rib or intercostal space. Because of the latter fact it is commonly utilised as a landmark in the operation of tapping the chest (paracentesis thoracis or thoracentesis).

The **spines of the vertebrae**:

Cervical spines—see page 38.

1st thoracic—next below the 7th cervical spine. It is frequently more prominent than the 7th cervical spine.

3rd thoracic—opposite the root of the spine of the scapula, the arm being by the side.

7th thoracic—opposite the inferior angle of the scapula, the arm being by the side.

12th thoracic—opposite the kidney angle (see page 69).

4th lumbar—opposite highest point of the iliac crest when looked at from behind.

2nd sacral—opposite the posterior superior iliac spine.

Coccyx—felt in the upper part of the cleft between the buttocks.

The OTHER SPINES may be identified by counting (by palpation) from those mentioned above. The student should practise this.

The **curves of the vertebral column** may be observed by studying the spines of the vertebrae. Since abnormalities in these curves are of common occurrence and great importance, a thorough acquaintance with the normal curves is essential.

The latter may be tabulated as follows :—

- Normal curves of vertebral column
  - antero-posterior
    - concave anteriorly
      - thoracic
      - sacro-coccygeal
    - convex anteriorly
      - cervical
      - lumbar
  - lateral—convex towards the right (usually)—thoracic.

The thoracic and sacro-coccygeal curves, which are concave anteriorly, appear of course as convexities in the line of the vertebral spines; whereas the cervical and lumbar curves, which are convex anteriorly, appear as concavities in the line of the spines.

It will be recalled that the curves which are concave anteriorly are known as PRIMARY CURVES, being developed during pre-natal life, whilst those which are concave posteriorly are known as SECONDARY CURVES, and are developed during post-natal life, in connection with the assumption by the child of the upright attitude. The student should verify this by observing the curves in young infants as the opportunity arises.

The LATERAL CURVE IN THE THORACIC REGION must be looked for with care, and is best examined by marking the tips of the vertebral spines in that region. It is usually but slightly marked, and in some individuals it can scarcely be demonstrated at all.

It is said to be convex towards the right in right-handed individuals, and convex towards the left in left-handed individuals, its existence being ascribed to the pull of those arm muscles which arise from the spines. Be that as it may, the important fact remains that a small degree of lateral curvature in the thoracic region may be perfectly normal.

Since it is important to understand the relationships between the abnormal curves of the vertebral

column and those which are normal, the three principal abnormal curves may be mentioned:

(1) KYPHOSIS is an abnormal curvature of the spine, concave anteriorly, and in this respect it may be likened to the normal thoracic curve.

(2) LORDOSIS is an abnormal curvature of the spine, concave posteriorly, and in this respect it may be likened to the normal lumbar curve, of which indeed it is usually an exaggeration. It may be noted that in women a certain degree of lordosis during the later months of pregnancy may be physiological—an attempt to preserve the proper position of the centre of gravity of the body.

(3) SCOLIOSIS is an abnormal curvature of the spine, concave to one side or the other, and in this respect it may be likened to the normal lateral thoracic curve, of which it is frequently an exaggeration.

The **subarachnoid space** with its contained **cerebro-spinal fluid** extends inferiorly as far as the 2nd or 3rd sacral vertebra.

The **spinal medulla** (**cord**) extends inferiorly

(*a*) in the *adult*, to the 1st or 2nd lumbar vertebra,

(*b*) in the *infant*, to the 3rd lumbar vertebra.

In the operation of lumbar puncture, which every practitioner should be able to perform, the object is to introduce a hollow needle into the subarachnoid space without injuring the spinal cord. It is obvious that the space available for this procedure is limited

superiorly by the inferior end of the spinal cord,
inferiorly by the inferior end of the subarachnoid space.

From the foregoing surface anatomy it follows that the needle may be introduced anywhere within the following limits :—

superiorly, (*a*) in the *adult*, the 2nd lumbar spine,
(*b*) in the *infant*, the 3rd lumbar spine;
inferiorly, the 2nd sacral spine.

It is clear that the 4th lumbar spine, which, on account of the facility with which it may be identified (see page 64), is the usual landmark for the insertion of the needle, falls within the above limits in patients of all ages.

Under certain circumstances it may be desirable to know something of the surface relationships of the **segments of the spinal medulla.**

The student will recall that the segments of the cord correspond to the attachments of the roots of the spinal nerves, and are therefore classified as follows :—

8 cervical,
12 thoracic,
5 lumbar,
5 sacral,
1 coccygeal.

The fact that while typically there are 33 vertebrae there are but 31 spinal nerves and segments renders it obvious that the segments of the cord cannot exactly correspond topographically to the similarly named vertebrae, while the fact that the spinal cord stops at the 1st or 2nd lumbar vertebra—*i.e.* that the coccygeal segment of the cord is topographically related to this vertebra—indicates that this lack of topographical

correspondence is very considerable. The reason of this is to be found in the fact that while at one period of intra-uterine life the spinal cord is co-extensive with the vertebral column, subsequently the latter outgrows the former. The spinal cord being fixed at its superior extremity to the brain, the result of this inequality in growth is that (1) except in the uppermost cervical region, each vertebra comes to lie at a lower level than the similarly designated segment of the spinal cord, and, further, that (2) this topographical discrepancy increases from above downwards, culminating in the relationship of the coccygeal segment to the 1st or 2nd lumbar vertebra.

This matter is of clinical significance from at least two principal points of view :

(*A*) In certain cases, for example in spinal injuries, it may be desired to know which segments of the cord are topographically related to certain vertebrae—and hence the surface relationships of such segments.

(*B*) In other cases, such as tumours affecting the spinal cord, one may wish to know which vertebrae—and hence which surface regions—are topographically related to certain spinal segments.

Since it must be an exceedingly rare occurrence indeed for a general practitioner to require to utilise the details of these relationships without having the opportunity of consulting a work of reference, it would appear to the author to be sufficient if the student remember the general statements made above, and refer to some more encyclopaedic source of information for such details as he may require.

The **sacro-spinalis** (**erector spinae**) is a large, fleshy, vertical column of muscle upon either side of the mid-

dorsal line. It is especially well developed in the lumbar region, where its lateral border can be felt, and sometimes seen, in the living person.

The **kidney angle** is the angle between

(1) the lateral border of the sacro-spinalis,

(2) the 12th rib.

It should be identified by carefully palpating these two structures.

It is so called because it is situated dorsal to the kidney (see page 96), and tenderness may be elicited there in some cases of kidney disease.

The angle is usually situated in the mid-scapular line opposite the 12th thoracic spine, and indicates the point where the inferior border of the pleura crosses anterior to the 12th rib (see page 71).

It should be borne in mind that the 12th rib may fail to reach the lateral border of the sacro-spinalis, in which case the kidney angle is formed by the muscle and the 11th rib. This may be of considerable consequence in an operation upon the kidney, though of course a previous X-ray examination reveals the actual condition of the lower ribs.

Certain arbitrary **lines** are utilised for purposes of anatomical and clinical description in the trunk region, and the three most important of these should be marked:

(1) The **mid-clavicular line** is a vertical line passing superficial to the mid-point of the clavicle.

(2) The **mid-axillary line** is a vertical line drawn inferiorly on the side of the trunk from the middle of the axilla.

(3) The **mid-scapular line** is a vertical line passing superficial to the middle of the inferior angle of the scapula.

If the mid-scapular line be produced inferiorly, it will be found to pass through, or near, the apex of the kidney angle, and hence to coincide with the lateral border of the sacro-spinalis muscle in the lumbar region. This is of consequence in connection with the important relation of the pleura to the 12th rib (see page 71).

The **pleura**.

I. The **cervical pleura**—see page 47.

II. The **anterior border**:

(*a*) of the RIGHT pleura, is indicated by a line
from the right sterno-clavicular joint
inferiorly and medially *to* the centre of the manubrium sterni,
then straight inferiorly *to* the middle of the xiphi-sternal joint;

(*b*) of the LEFT pleura, is indicated by a line
from the left sterno-clavicular joint
inferiorly and medially *to* the centre of the manubrium sterni, as on the right side,
then straight inferiorly *to* the level of the 4th costal cartilage,
next laterally *to* the 4th left sterno-costal joint,
and *finally* inferiorly, along the left border of the sternum *to* the 6th left sterno-costal joint.

III. The **inferior border** on both sides is indicated by a line

from the inferior extremity of the line representing the anterior border,
crossing (1) the **8th** rib in the MID-CLAVICULAR LINE,
(2) the **10th** rib in the MID-AXILLARY LINE,
(3) the **12th** rib in the MID-SCAPULAR LINE,
and *ending* about 1 in. (2·5 cm.) lateral to the 12th thoracic spine.

Note the figures—8, 10, 12.

Since the 12th rib and the pleura form posterior relations of the kidney, the relationship of the pleura to the rib is of importance in kidney operations, and should be thoroughly understood. The inferior border of the pleura is nearly horizontal behind, whereas the 12th rib is very oblique, its lateral extremity being on a considerably lower level than its medial extremity. Therefore, as the surface marking shows, the inferior border of the pleura crosses (anterior to) the 12th rib in the mid-scapular line, at the kidney angle (see page 69), so that whereas lateral to the kidney angle the pleura falls short of the 12th rib, medial to that angle the pleura extends below the 12th rib—*i.e.* the pleura emerges from the shelter afforded by the ribs, though still protected by the overlying sacro-spinalis (*cf.* the cervical pleura, page 48).

The student requires to study the surface anatomy of the following parts of the **lung** :—

I. the apex,
II. the anterior border,
III. the inferior border,
IV. the oblique fissure,
V. the transverse fissure (of the right lung),
VI. the various lobes,
VII. the root.

For ordinary clinical purposes it is not necessary to mark the posterior border of the lung (and pleura).

I. The **apex** of the lung—see page 47.

II. The **anterior border**:

(*a*) of the RIGHT lung, practically corresponds to the anterior border of the right pleura (*vide supra*);

(*b*) of the LEFT lung, is indicated by a line practically corresponding to that which marks the anterior border of the left pleura as far as the level of the 4th costal cartilage,

then laterally along the 4th left costal cartilage

to a point about 1 in. (2·5 cm.) lateral to the left border of the sternum,

and *finally* inferiorly and slightly medially

to the 6th left costal cartilage.

III. The **inferior border** on both sides is indicated by a line drawn

from the inferior extremity of the line representing the anterior border,

crossing (1) the 6th rib in the MID-CLAVICULAR LINE,

(2) the 8th rib in the MID-AXILLARY LINE,

(3) the 10th rib in the MID-SCAPULAR LINE,

and *ending* about 1 in. (2·5 cm.) lateral to the 10th thoracic spine.

Note the figures—6, 8, 10—and compare them with the corresponding figures for the inferior border of the pleura. Observe that in each of the three vertical lines (mid-clavicular, mid-axillary and mid-scapular) the inferior border of the lung lies *two ribs higher* than that of the pleura.

In YOUNG CHILDREN the inferior border of the lung is *about one rib higher* than in adults.

In view of the fact that the level of the inferior border of the lung varies according to the phase of respiration, it will be understood that the above marking represents but its average level.

A comparison of the surface marking of the inferior border of the lung with that of the corresponding border of the pleura illustrates the fact that ordinarily a considerable interval exists between them. This interval, known as the PHRENICO-COSTAL SINUS, is the lowest portion of the pleural cavity, into which the inferior border of the lung descends only upon deep inspiration. It receives its name from the fact that it is bounded deeply by the diaphragm and superficially by the ribs and intercostal muscles. Its surface anatomy shows that it exists as a broad strip on each side of the body, and when the surface anatomy of the abdominal organs has been studied it will be seen to lie superficial to the following organs from before backwards :

(*a*) on the right side,
  (1) the right lobe of the liver,
  (2) the superior pole of the right kidney ;

(*b*) on the left side,
  (1) the left lobe of the liver,
  (2) the stomach,
  (3) the spleen,
  (4) the superior pole of the left kidney.

The practical significance of these relationships will be touched upon under the headings of the various organs named (see pages 71, 91, 92 and 94).

IV. The **oblique fissure** of the lung is indicated by a line *from* a point about 1 in. (2·5 cm.) lateral to the 2nd thoracic spine

to the 6th costal cartilage medial to the mid-clavicular line.

V. The **transverse fissure** of the right lung is indicated by a line

from a point on the line representing the anterior border opposite the 4th costal cartilage

to the right and slightly upwards to meet the line representing the oblique fissure in the mid-axillary line.

VI. The surface anatomy of the various **lobes** of the lungs is to be studied according to the method adopted in the study of the surface anatomy of the triangles of the neck (see page 46). The student will observe that, the borders and fissures of the lungs being marked, all that is necessary in order to study the surface anatomy of the lobes is to recall the boundaries of the various lobes and the surface markings of those boundaries. He may be reminded that the right lung possesses two fissures, (*a*) the oblique fissure and (*b*) the transverse fissure, whereas the left lung possesses the oblique fissure only. Therefore the right lung possesses three lobes, (1) the superior lobe, (2) the middle lobe and (3) the inferior lobe, while the left lung has but two lobes, (1) the superior lobe and (2) the inferior lobe.

In view of their clinical importance the student should practise marking the individual lobes on both sides. Such a study will make it clear that clinically (*a*) the upper lobe is best examined from the front, (*b*) the lower lobe is best examined from behind and from the side, while (*c*) the middle lobe of the right lung is best examined from the front and from the side.

VII. The **root** of the lung is best marked in upon the back, for, since it lies nearer to the posterior wall

of the thorax than to the anterior wall, it is best examined from the back.

It lies deep (anterior) to the surface area between the 4th, 5th and 6th thoracic spines and the vertebral border of the scapula.

This area includes the so-called *triangle of auscultation*, concerning which the student might refresh his memory.

The thoracic portion of the internal mammary artery is indicated by a vertical line about $\frac{1}{2}$ in. (1·25 cm.) lateral to the side of the sternum, extending down to the 6th intercostal space, where the artery ends by dividing into its two terminal branches the musculo-phrenic and the superior epigastric.

It is sometimes injured in stab wounds or in accidents.

A comparison of the surface marking of this artery with that of the anterior border of the pleura recalls the fact that the vessel lies anterior to the pleura, so that during the operation of ligation of the artery care must be taken to avoid injuring this membrane from which the vessel is separated only by the slips of the transversus thoracis (triangularis sterni).

The outline of the heart.

I. Typically the **apex** of the heart is situated deep to the 5th left intercostal space, about $3\frac{1}{2}$ in. (8·75 cm.) from the mid-line. In males and immature females this is usually slightly below and medial to the nipple. The pulsations of the apex are commonly visible in this situation.

In CHILDREN, as compared with adults, the heart's apex lies *slightly higher up and further laterally.*

Consideration at this point of the surface anatomy of the left lung and pleura will recall the fact that the apex of the heart is separated from the thoracic wall (*i.e.* from the ribs and intercostal muscles) by the left lung and pleura—in addition to the pericardium, of course. This anatomical relation is the cause of the fact that pleural friction synchronising with the heart-beats is heard over the apex of the heart in certain cases of pleurisy involving this region of the pleura. Such a phenomenon must be distinguished from a cardiac murmur.

II. The **left border** of the heart is represented by a line, convex to the left,

from the 2nd left costal cartilage about 1 in. (2·5 cm.) from the lateral border of the sternum

to the apex.

III. The **right border** of the heart is indicated by a line, slightly convex to the right,

from the 3rd right costal cartilage about $\frac{1}{2}$ in. (1·25 cm.) from the lateral border of the sternum

to the 6th right costal cartilage about $\frac{1}{2}$ in. (1·25 cm.) from the lateral border of the sternum.

The summit of the convexity of this line may approximate to a distance of 1 in. (2·5 cm.) from the right border of the sternum in the 4th intercostal space.

IV. The **superior** and **inferior borders** of the heart are represented by lines joining the superior and inferior extremities respectively of the lines marking the right and left borders. The line of the inferior border passes superficial to the xiphi-sternal joint.

When marking in the heart, the student, bearing in mind that the right ventricle lies partly anterior to the left ventricle as well as to the right of it, should visualise the following facts :—

(1) the *apex* is formed by the left ventricle,
(2) the *left border* is formed mainly by the left ventricle,
(3) the *superior border* is formed by both atria (auricles),
(4) the *right border* is formed by the right atrium,
(5) the *inferior border* is formed mainly by the right ventricle.

It must be understood that the above markings are those of what is commonly considered an average heart, and that the heart of any given individual may vary somewhat in its surface relationships from the average given above, and yet be normal for that individual. When the student has acquired the clinical art of percussion he will be able to ascertain the surface anatomy of the heart of any individual, and then he will require to utilise the above markings as a standard with which to compare his findings in the individual case. The significance of departures from the average can be determined only upon a consideration of all the features and aspects of the case, and in such matters the student will be educated in the department of medicine.

The **area of superficial or complete cardiac dullness** is the surface area overlying that portion of the anterior surface of the heart which is uncovered by lung. In order to study it, it is therefore necessary, in addition to having the heart marked in, to mark also those portions of the anterior and inferior borders of both lungs which are related to the heart. When this is done the area as defined above will become obvious. It is bounded by

(1) the anterior borders of both lungs, from their divarication opposite the 4th costal cartilages, downwards;
(2) a line joining the inferior extremities of those borders.

It will be observed that the left portion of this area is related to the left pleura.

Since this area is completely devoid of overlying lung, it yields a dull note upon percussion, be that percussion light or heavy; hence its name, which is in contrast to the **area of deep or relative cardiac dullness.**

The latter is simply the area included within the surface outline of the whole heart, and is so named because, the anterior aspect of the heart being overlaid by lung (except at the area of superficial cardiac dullness), it requires fairly heavy percussion to elicit the dullness due to the presence of the heart.

The student must understand clearly that the boundaries of the area of deep cardiac dullness are simply the surface markings of the various borders of the heart, for it is by ascertaining the boundaries of this area by the method of percussion that the physician determines the surface anatomy of the heart in the individual case, as referred to above.

It is obvious that the area of superficial cardiac dullness is a small area included within the larger area of deep cardiac dullness.

Both areas of cardiac dullness are of great clinical importance. Since, as emphasised above, the boundaries of the area of deep cardiac dullness correspond to the surface markings of the borders of the heart, it is clear that alterations in this area are due principally to alterations in the size or in the position of the heart itself (including the pericardium) — for example a dilated heart, a pericardial effusion, or dextro-cardia.

On the other hand, since the principal boundaries of the area of superficial cardiac dullness correspond to the surface markings of portions of the anterior borders of the lungs, it is equally clear that alterations in this area may be brought about by conditions affecting the lungs. For example, an increase in the area may be due to retraction of the anterior border of one or both lungs, such as occurs in some forms of phthisis ; while the area may be diminished in certain cases of emphysema, in which the anterior borders of the lungs are ballooned forwards.

The surface anatomy of the **valves of the heart** is of little direct clinical significance to the general practitioner; nevertheless the student should mark them in, as this knowledge is necessary to an intelligent comprehension of certain matters of the greatest importance presently to be discussed. He need scarcely burden his memory with the detailed facts, however.

I. The **mitral** (BICUSPID) **valve** is indicated by a short line, sloping from above downwards and to the right, over the left half of the sternum, opposite the 4th sterno-costal joint.

II. The **tricuspid valve** is represented by a line longer than that marking the mitral valve, but sloping like the latter, over the right half of the sternum, opposite the 4th intercostal space and the 5th sterno-costal joint.

III. The **aortic valve** is indicated by a short line, sloping like the two preceding, over the left side of the sternum, opposite the inferior half of the 3rd left sterno-costal joint and the superior half of the 3rd left intercostal space.

IV. The **pulmonary** valve is marked in by a short

horizontal line over the superior border of the 3rd left costal cartilage, just lateral to the side of the sternum.

The student may experience some degree of surprise upon observing that the line representing the aortic valve, which is related to the left ventricle, lies to the right of that representing the pulmonary valve, which is related to the right ventricle. This will be understood, however, upon recalling the fact already mentioned that the right ventricle lies largely anterior to the left ventricle, and that the valves are so situated that the pulmonary valve actually lies slightly to the left of the aortic valve, though of course in a more anterior plane.

The cardiac valves are discussed further on page 82, but before proceeding thereto the surface anatomy of the two great arteries which arise from the heart, the aorta and the pulmonary artery, must be studied.

The **aorta.**

I. The **ascending aorta** is represented by a very broad line

from the line indicating the aortic valve

to the 2nd right sterno-costal joint.

The student will recall that the ascending aorta runs slightly anteriorly, as well as superiorly and to the right, so that the aorta is most superficial at the point where it lies posterior to the 2nd right sterno-costal joint. For this reason the 2nd right costal cartilage is frequently styled *the aortic cartilage.*

II. The **arch of the aorta** is represented by a very broad line

from the point of termination of the ascending aorta

to a corresponding point on the left side,

crossing the inferior half of the manubrium sterni in a curve, convex superiorly, the summit of the curve reaching the middle of the manubrium — slightly higher that than in children.

III. The **descending thoracic aorta** is indicated by a very broad line

from the point of termination of the arch

to a point in the mid-line about ½ in. (1·25 cm.) above the trans-pyloric plane (see page 89).

The latter point marks the plane where the aorta passes through (or rather behind) the diaphragm.

IV. The **abdominal aorta** is represented by a very broad line

from the point of termination of the descending thoracic aorta

to a point about ½ in. (1·25 cm.) inferior and to the left of the umbilicus.

The latter point marks the bifurcation of the abdominal aorta into the right and left common iliac arteries, and if the umbilicus be considered an unreliable landmark (see page 84), the point may be determined with sufficient accuracy by remembering that it is on a level with the highest points of the iliac crests seen from the front.

If the student again mark in the oesophagus on the anterior aspect of the body, the surface markings of that structure and of the aorta will remind him of their intimate topographical relationship, which is of clinical significance, for example in certain aortic aneurysms.

The surface anatomy of the abdominal aorta is deserving of careful study, for in certain conditions its pulsations may be easily felt, and some abdominal swellings receive from it a transmitted pulsation.

Moreover, there is a method (Macewen's) of compressing the abdominal aorta through the anterior

abdominal wall, and should recourse be had to this procedure a knowledge of the surface anatomy of the vessel is essential.

The **pulmonary artery** is indicated by a broad line
from the line representing the pulmonary valve
to the 2nd left costal cartilage immediately lateral to the side of the sternum.

The student will realise that this short line, running straight upwards, is but the projection upon the surface of the fairly long pulmonary artery, which runs backwards as well as upwards.

The auscultatory areas of the heart.

The physician's interest in the surface anatomy of the cardiac valves is actuated by his desire to listen with his stethoscope to the sounds produced at these valves, from which procedure he derives information of great value.

The student who has acquired proficiency in the art of auscultation will appreciate from their surface anatomy the fact that the valves are grouped so closely together that were he to listen actually over the valves he would be unable to distinguish the sounds produced at each individual valve, which is an indispensable part of the method.

The sounds produced at each valve are therefore listened to over certain arbitrarily selected areas known as the auscultatory areas. These areas, although determined arbitrarily, are by no means selected at random. On the contrary, their situations conform to certain anatomical and physiological

principles which are worth understanding since they are closely related to the principles which determine the direction of propagation of certain " murmurs " or abnormal sounds produced at the cardiac valves.

(*a*) The areas are as far apart as possible, in order that the sounds produced at any given valve may be clearly distinguished from those produced at the other valves.

(*b*) Since the blood-stream tends to carry the sound in the direction in which it is flowing, each area is situated superficial to the chamber or vessel which the blood enters after passing through the valve in question. When applying this principle to the several valves the course of the blood-stream through the heart must be recalled.

(*c*) In order that the sounds may be heard as clearly as possible each area overlies a superficial region of the chamber or vessel in question.

Each area is named according to the valve the sounds of which are heard thereat; and in each case the student should adduce facts which show that the area in question conforms to the three principles enunciated above.

(1) The **mitral area** is situated superficial to the apex of the heart.

(2) The **tricuspid area** is situated superficial to the inferior extremity of the body of the sternum.

(3) The **aortic area** is situated superficial to the medial extremity of the 2nd right costal cartilage (the " aortic cartilage ").

(4) The **pulmonary area** is situated superficial to the medial extremity of the 2nd left intercostal space.

Even the junior student should lose no opportunity of listening to the heart sounds at each of these areas.

The **umbilicus** varies somewhat in position, its exact situation depending upon such factors as the degree of obesity, the tone of the abdominal muscles, or distension of the abdomen. On this account it is somewhat unreliable as a landmark, although in spite of this it is sometimes utilised because of its convenience. It may be noted that normally the umbilicus is depressed, an umbilicus flush with the surface or protruding commonly indicating the presence of fluid within the abdomen (ascites).

The **linea semilunaris** is a slight surface depression indicating the lateral border of the rectus abdominis, and visible with ease if that muscle be made to contract, or even without this in persons of good muscular development.

Corresponding to the lateral border of the rectus, this depression sweeps in a gentle curve, convex laterally, from the pubic tubercle towards the costal margin. (The attachments of the rectus abdominis should be recalled.) It usually meets the costal margin at the 9th costal cartilage (see page 91).

Not infrequently the superior and inferior extremities of the depression are indistinct, but the position of the lateral border of the rectus in these regions is easily inferred from the general direction of the main portion of the linea semilunaris.

In abdominal operations it is well to know approximately where to expect the lateral border of the rectus abdominis; and a knowledge of its surface anatomy is also of assistance in the diagnosis of those curious

" phantom tumours " which are due to the contraction of one of the segments into which the muscle is divided by its tendinous interscriptions. The situations of the latter are sometimes indicated by slight transverse depressions.

The **inguinal (Poupart's) ligament** extends, with a slight concavity upwards,

from the anterior superior iliac spine

to the pubic tubercle.

It is of great importance in connection with hernia.

The **lacunar (Gimbernat's) ligament** is situated immediately lateral to the pubic tubercle and deep to the medial 1 in. (2·5 cm.) or thereby of the inguinal ligament. It is also of importance in cases of hernia.

The **mid-inguinal point** is a point on the inguinal ligament mid-way between the anterior superior iliac spine and the symphysis pubis. Therefore it does not coincide with the mid-point of the inguinal ligament, but lies slightly medial to the latter point.

The **abdominal (or deep) inguinal (internal abdominal) ring** is represented upon the surface by an ellipse with

its *long axis* vertical and measuring about $\frac{1}{2}$ in. (1·25 cm.),

its *short axis* measuring about $\frac{1}{4}$ in. (0·6 cm.), and

its *centre* about $\frac{1}{2}$ in. (1·25 cm.) above the mid-inguinal point.

In an INFANT the dimensions are smaller of course, and the ring is almost immediately above the inguinal ligament.

The **subcutaneous (or superficial) inguinal (external abdominal) ring** is indicated upon the surface by an elongated triangular figure, measuring about $\frac{3}{4}$ in. (2 cm.) from base to apex, with its base—about $\frac{1}{4}$ in. (0·6 cm.) long—at the pubic crest immediately medial to the pubic tubercle, the triangle sloping upwards and laterally so that its apex lies just lateral to a vertical line drawn through the pubic tubercle.

In MALES it can be examined by invaginating the scrotum as described on page 61.

In FEMALES and in CHILDREN its dimensions are much less than those given above. In MALE INFANTS, when examined by invaginating the scrotum, it should not normally admit the tip of the average adult little finger. If it does so, the presence of a hernia may be suspected.

Since the **inguinal canal** extends from one inguinal ring to the other, it is represented upon the surface by a broad line joining the markings of the two rings. It will be observed to lie immediately superior and parallel to the medial half (approximately) of the inguinal ligament. It is about $1\frac{1}{2}$ in. (3·75 cm.) in length in an ADULT and about half that length in an INFANT.

The importance of the inguinal canal and rings in connection with hernia is usually so well known to students that nothing need be said concerning this matter here.

The **common** and **external iliac arteries** are represented by a line drawn

from the point indicating the bifurcation of the abdominal aorta (see page 81)
to the mid-inguinal point.

The COMMON ILIAC ARTERY is represented by the *upper third* of this line, and the EXTERNAL ILIAC ARTERY by its *lower two-thirds*.

The **inferior (deep) epigastric artery** is indicated by a line

from the mid-inguinal point
to the umbilicus.

The origin of the vessel is represented by the mid-inguinal point because it arises from the termination of the external iliac, which ends at that point.

The inferior epigastric artery runs at first inferior and then medial to the abdominal inguinal ring, a relationship which sometimes assumes a practical importance in operations for the relief of hernia.

The surface anatomy of this artery must be borne in mind during the operation of tapping the abdomen (paracentesis abdominis) lest the vessel be injured by the needle.

In order to study the surface anatomy of **Hesselbach's triangle** the student has now but to recall its boundaries, for these have already been marked. They are :

inferiorly, the inguinal ligament and the pubis ;
medially, the lateral border of the rectus abdominis ;
laterally, the inferior epigastric artery.

The surface anatomy of this region illustrates the following facts :—

(1) Since the inferior epigastric artery runs inferior and then medial to the abdominal inguinal ring, it follows that that ring lies immediately lateral to Hesselbach's triangle.

(2) The subcutaneous inguinal ring, being lateral to the lateral border of the rectus abdominis, lies in the medial angle of Hesselbach's triangle, just above its base.

(3) Since the inguinal canal lies just above and parallel to the inguinal ligament, it therefore lies within Hesselbach's triangle, just above and parallel to its base. The only portion of the inguinal canal which might possibly be considered to lie outside the boundaries of Hesselbach's triangle is its extreme lateral end, into which the abdominal inguinal ring opens.

The **lumbar triangle** (**of Petit**) is inconstant in size, usually small, and sometimes absent. It is situated immediately above the iliac crest, just behind the middle of the crest. The student might refresh his memory as to the structures which form its boundaries and floor.

The significance of this triangle lies in the fact that, as a recollection of its anatomy will show, it constitutes a weak spot in the abdominal wall, through which a lumbar abscess or hernia occasionally emerges.

The various more or less complicated methods, such as those of Cunningham and of Addison, of arbitrarily subdividing the abdomen into numerous

planes and regions would appear to be of less clinical value than the simpler method of subdividing it into **four quadrants** by two planes,

(1) the median plane,

(2) a transverse plane mid-way between the xiphi-sternal joint and the symphysis pubis,

the four quadrants being named

(*a*) right superior,

(*b*) right inferior,

(*c*) left superior,

(*d*) left inferior.

Some prefer to define the transverse plane as passing through the umbilicus. It will be observed that the important RIGHT AND LEFT ILIAC FOSSAE correspond to the inferior and lateral portions of the right and left inferior quadrants respectively.

The **trans-pyloric plane** (of Addison), frequently utilised in abdominal topography, is a horizontal plane situated mid-way between the superior border of the sternum and the symphysis pubis, or, alternatively, approximately mid-way between the xiphi-sternal joint and the umbilicus. This plane passes through the pylorus (hence its name) and the lower portion of the body of the first lumbar vertebra.

The **liver.**

I. The **superior border** is marked by a line exhibiting gentle curves conforming to the known shape of the organ,

beginning over the 5th left rib, just medial to a VERTICAL LINE DRAWN THROUGH THE NIPPLE,

crossing the xiphi-sternal joint in the MID-LINE, the 4th intercostal space in the RIGHT MID-CLAVICULAR LINE,

the 6th intercostal space in the RIGHT MID-AXILLARY LINE,
the 8th rib in the RIGHT MID-SCAPULAR LINE, and
ending over the 9th rib in the LEFT MID-SCAPULAR LINE.

II. The **inferior border** is marked by a line exhibiting appropriate gentle curves,
beginning at the point representing the left extremity of the superior border in front,
crossing the left costal margin at the 8TH COSTAL CARTILAGE,
the trans-pyloric plane in the MID-LINE, $\frac{1}{2}$ in. (1·25 cm.) inferior to the costal margin in the RIGHT MID-CLAVICULAR LINE,
the 11th rib in the RIGHT MID-AXILLARY LINE (or, if the 11th rib fall short of the mid-axillary line, then the point at which this rib would cross the line were it—the rib—longer),
the 12th rib in the RIGHT MID-SCAPULAR LINE, and
ending at the point representing the left extremity of the superior border behind.

Although the inferior border of the liver lies below the right costal margin, the normal organ is so soft that it is not usually palpable.

The student's observations in the dissecting-room have shown him that normal livers vary considerably in size, shape and surface relationships. As in the case of the heart, the surface anatomy of the liver of each individual patient (in whom such an examination is called for) is determined by percussion, and is compared with that of an average or typical liver as given above.

A comparison of the surface anatomy of the lung with that of the liver illustrates the fact that the upper portion of the liver is separated from the chest wall by lung. Because of this, percussion designed to define the superior border of the liver must be sufficiently heavy to penetrate the resonant pulmonary tissue which separates the liver from the chest wall, and thus to elicit the dull liver note.

A comparison of the surface anatomy of the pleura with that of the liver demonstrates the feasibility of a trans-pleural approach to the liver in certain operations.

The student may be reminded that the liver of an INFANT is *relatively larger* than that of an adult.

The **fundus of the gall-bladder** lies deep to the point where the right linea semilunaris reaches the costal margin, at the 9th right costal cartilage.

Normally it is impalpable, but tenderness may be elicited here under certain abnormal conditions, and exceptionally a pathological gall-bladder may be palpable.

It will be recalled that the **spleen** lies deep to the 9th, 10th and 11th ribs. Its three angles are first to be marked, then its three borders.

I. The **superior angle** is represented by a point about $1\frac{1}{2}$ in. (3·75 cm.) to the left of the 10th thoracic spine;

II. The **anterior angle** by a point over the 9th left intercostal space in the mid-axillary line;

III. And the **inferior angle** by a point over the 11th left intercostal space about $3\frac{1}{2}$ in. (8·75 cm.) lateral to the 1st lumbar spine.

IV. The **anterior border** is indicated by a line
from the superior angle
to the anterior angle,
well arched upwards, the summit of the arch reaching the superior border of the 9th rib in the left mid-scapular line;

V. The **posterior border** is indicated by a line
from the superior angle
to the inferior angle;

VI. And the **inferior border** by a line
from the anterior angle
to the inferior angle.

The spleen is a difficult organ to mark in on the surface, and it is questionable if it is necessary for the student to memorise all the facts detailed above.

The examination of the spleen by percussion in the living patient is a highly important procedure in certain cases, and from this point of view the student should remember the surface anatomy of the anterior border and of the anterior angle, for the determination of the position of these by percussion is very important in the detection of splenic enlargement.

The outline of the spleen being marked in, the student should observe and note carefully the following facts :—

(1) normally no part of the spleen extends farther anteriorly than the mid-axillary line;
(2) the spleen is normally entirely under shelter of the ribs;
(3) the normal spleen is not palpable.

A comparison of the surface anatomy of the pleura with that of the spleen illustrates the feasibility of a trans-pleural splenic puncture which is sometimes performed with a hollow needle, a little splenic substance being withdrawn for diagnostic examination.

Since the **stomach** varies greatly in size, shape and position under a variety of circumstances, it would appear to be more profitable to pay especial attention to one or two important facts concerning its surface anatomy than to learn to draw an outline which almost to a certainty would not represent the actual viscus beneath.

I. The **cardiac (or oesophageal) orifice** of the stomach is represented on the surface by the point which indicates the inferior extremity of the oesophagus (see page 43).

II. The highest point of the **fundus** of the stomach is situated posterior to the 5th left rib in the mid-clavicular line.

III. The **pylorus** is represented by a point in the trans-pyloric plane (naturally !), usually immediately to the right of the mid-line.

A comparison of the surface anatomy of the heart with that of the fundus will remind the student of the close topographical relationship existing between the two, a relationship responsible for the cardiac manifestations which sometimes accompany certain gastric conditions.

Although the normal stomach is not palpable, the student should observe the very important fact that, whereas the pyloric end of the stomach, not being overlaid by ribs, is accessible for examination by palpation, the cardiac end, lying entirely beneath the ribs, is practically inaccessible for examination by this method.

The student should consult some larger work of reference for an account of the important physiological changes which occur in the shape and position of the stomach.

Traube's area is a surface area of considerable clinical importance. It overlies a portion of the stomach which is not separated from the body wall by any other viscus, and which therefore yields a tympanitic note upon percussion, since this portion of the stomach commonly contains gas.

To define the area its boundaries are to be marked in. They are :

superiorly, the inferior border of the left lung (see page 72) ;

to the right, the inferior border of the liver (see page 90) ;

inferiorly, the left costal margin ;

to the left, the anterior border of the spleen (see page 92).

If now the inferior border of the left pleura be marked in (page 70), the upper portion of the space will be seen to be related to the left phrenico-costal sinus (see page 73).

The student will probably experience some difficulty in marking Traube's area, but it merits study, for clearly it may be altered in certain affections of the related organs, such as splenic or hepatic enlargement or any condition producing retraction of the left lung.

The **duodeno-jejunal flexure** lies immediately inferior to the trans-pyloric plane, about 1 in. (2·5 cm.) to the left of the median plane.

As a rule so little definite information is obtained by attempting to palpate the **duodenum** that it is scarcely worth the trouble of committing to memory any detailed surface markings thereof. Recalling that

the duodenum commences at the pylorus and ends at the duodeno-jejunal flexure, the markings of both of which have been stated above, the remainder of its surface anatomy can be judged with sufficient accuracy from its general anatomy.

The **pancreas** lies within the curve of the duodenum, and extends to the left as far as the spleen.

The **jejuno-ileum** is present to a greater or less extent in all four quadrants of the abdomen. Broadly speaking, the JEJUNUM tends to lie high up and to the left, the ILEUM low down and to the right.

The **caecum** lies in the right iliac fossa (see page 89).

The **base of the vermiform process (appendix)** lies deep to a point about 1 in. (2·5 cm.) inferior to the intersection of

(1) a line drawn vertically upwards from the mid-inguinal point,
(2) a horizontal line passing over the tubercles on the iliac crests.

The *body* of the appendix may lie in practically any direction.

The **right colic (hepatic) flexure** lies lateral to the junction of the linea semilunaris and the right costal margin.

The **ascending colon** extends from the right iliac fossa to the right colic flexure, lateral to a line drawn vertically upwards from the mid-inguinal point.

The **left colic (splenic) flexure** corresponds somewhat in position to the right colic flexure, but lies rather higher up and further laterally.

From their relationship to the ribs it will be observed that the right and left colic flexures can be examined by palpation with difficulty if at all, and that this is especially true of the left colic flexure.

The **transverse colon** extends between the right and the left colic flexures. It may hang down to almost any level.

The **descending colon** corresponds in position to the ascending colon, except, of course, that it is on the left side.

The **iliac colon** lies in the left iliac fossa, in a position corresponding to that of the caecum.

It is obvious that a knowledge of the surface anatomy of those portions of the intestine which are in the abdomen proper is indispensable in any examination of the abdomen.

There are two common methods of marking in the **kidneys**. One is by direct deduction, so to speak, from their general anatomy; the other is Morris's parallelogram.

I. For the **first method** the following facts must be recalled :—

(1) the *length* of the kidney is about $4\frac{1}{2}$ in. (11·25 cm.);

(2) its *breadth* is about $2\frac{1}{2}$ in. (6·25 cm.);

(3) the *hilum* lies (*a*) in the neighbourhood of the trans-pyloric plane,
(*b*) about 2 in. (5 cm.) lateral to the median plane;

(4) although the breadth is $2\frac{1}{2}$ in. (6·25 cm.), the slope of the kidney reduces this to about $1\frac{1}{2}$ in. (3·75 cm.) when projected on to the surface—the student must understand this; hence the *most lateral point of the lateral border* is about $2+1\frac{1}{2}=3\frac{1}{2}$ in. ($5·0+3·75=8·75$ cm.) lateral to the median plane;

(5) owing to the manner in which the kidneys are tilted, the *superior* pole lies about 1 in. (2·5 cm.) from the median plane—*i.e.* it is nearer the median plane than is the inferior pole;

(6) owing to the preponderance of the right lobe of the liver, the right kidney lies at a slightly lower *level* than does the left.

Outlines of both kidneys are to be drawn on the *anterior* and *posterior* aspects of the body, conforming strictly to all the facts detailed above.

II. **Morris's parallelogram.** The kidney lies deep to the surface area included within a parallelogram bounded

(1) by two VERTICAL lines drawn
from the level of the 11th thoracic spine
to the level of the 3rd lumbar spine,
(a) *the one* a distance of 1 in. (2·5 cm.) lateral to the mid-line,
(b) *the other* a distance of $3\frac{1}{2}$ in. (8·75 cm.) lateral to the mid-line;

(2) by two HORIZONTAL lines joining respectively the superior and the inferior extremities of the two vertical lines.

Although rather more difficult than the parallelogram, the author prefers the first method because (1) it is deduced from facts which have been learned already, thus eliminating the necessity of memorising additional facts (it is true that the other method has been deduced in like fashion, but the deduction is not quite so obvious); and (2) by the first method the kidneys can be marked in on both anterior and posterior aspects of the body, whereas the parallelogram is applicable only to the back—unless the levels of the vertebral spines be carried round to the front.

The normal kidney is rarely if ever palpable, though a highly mobile kidney may be.

A comparison of the surface anatomy of the kidneys with that of various other structures will recall important relationships. In this connection especial attention should be paid to the " kidney angle " and the structures forming it (see page 69) and to the pleura.

Like the kidney, the **abdominal portion of the ureter** is to be marked in upon both the anterior and the posterior aspects of the body.

I. If it be recalled that the abdominal portion of the ureter extends from the hilum of the kidney to the point where the ureter crosses the bifurcation of the common iliac artery, it will be easily understood that on the ANTERIOR aspect of the body the abdominal portion of the ureter is indicated by a line

from the point representing the hilum of the kidney (see above)

to the point representing the bifurcation of the common iliac artery (see page 86).

II. On the POSTERIOR aspect of the body the abdominal portion of the ureter is indicated by a line

from the point representing the hilum of the kidney

to the posterior superior iliac spine (see page 62).

CHAPTER IV

THE SUPERIOR EXTREMITY

The acromion process of the scapula.

I. The **superior surface** is subcutaneous, and may be traced medially to the acromio-clavicular joint (page 39).

II. The **lateral border** may be followed *posteriorly* with the fingers until it meets the inferior border of the spine of the scapula at the ACROMIAL ANGLE. The latter is frequently utilised as a measuring point when measuring the length of the upper limb—for example in fracture of the humerus. Followed *anteriorly*, the lateral border may be felt to end in the point of the shoulder (THE TIP OF THE ACROMION PROCESS).

For the surface anatomy of the *coracoid process of the scapula* see page 56, for the remainder of the scapula see page 63, and for the *clavicle* see page 39.

The **head of the humerus** and the **shoulder joint** are so surrounded and protected by muscles upon all sides except inferiorly that they can be examined only by fingers pushed well up into the axilla. The head of the humerus may be identified by its movements when the arm is moved, care being taken that the scapula does not move (page 63).

During this examination the arm should not be fully abducted, as this renders the axillary fascia so tense as to impede the palpation of the deeper structures.

The **greater tuberosity of the humerus** is felt on deep palpation through the deltoid muscle below the lateral border of the acromion process, the arm hanging by the side. It may be grasped from before backwards.

The student should observe carefully that in this position the greater tuberosity is the most lateral bony point of the shoulder, thus giving the latter its rounded contour. On this account a straight line—for example the edge of a long ruler—applied against the lateral aspect of the arm cannot touch the lateral epicondyle of the humerus (page 103) and the acromion process simultaneously. The student should test this. Such a straight line is sometimes known as HAMILTON'S LINE. The alteration of these normal anatomical relationships constitutes a very important diagnostic feature of dislocations of the shoulder. It will be noticed that if the arm be abducted the greater tuberosity disappears beneath the acromion process so as to be no longer palpable.

The **lesser tuberosity of the humerus** may be felt with difficulty upon deep palpation through the deltoid muscle on the anterior aspect of the arm, about 1 in. (1·25 cm.) lateral to and slightly below the tip of the coracoid process. Rotation of the arm may facilitate its identification.

The **deltoid** is the muscular mass which, together with the disposition of the bony points, is mainly responsible for the rounded contour of the shoulder. The latter feature is therefore diminished if the muscle suffer atrophy.

Its *insertion* is placed about the middle of the lateral aspect of the upper arm.

On the anterior aspect of the shoulder region a faint *delto-pectoral groove* or a prominent *cephalic vein* may indicate the interval between the deltoid and the pectoralis major.

The **biceps brachii.**

I. The **long head** is represented by a line drawn from the tip of the acromion straight down the front of the arm for about 2 in. (5 cm.).

This tendon is enclosed in a prolongation of the synovial membrane of the shoulder joint, therefore deep palpation along this line may elicit tenderness in some cases of shoulder joint disease.

II. The **belly** of the biceps raises an easily recognised swelling on the front of the arm if the muscle be made to contract.

The brachial artery is felt pulsating deep to the medial border of the belly of the biceps.

III. The **tendon** of the biceps is easily felt crossing the front of the elbow, immediately lateral to its middle, especially if the elbow be flexed.

The brachial artery may be felt pulsating medial to the tendon of the biceps, particularly with the elbow extended.

The **coraco-brachialis** may be observed as a fusiform swelling in the lateral wall of the axilla and the proximal portion of the medial aspect of the arm, the latter being abducted.

The third portion of the axillary artery is felt pulsating posterior to this swelling.

The **tendon of the triceps** is easily felt extending down the distal portion of the posterior aspect of the arm to its insertion into the olecranon process of the ulna.

The fingers can be pressed inwards on both sides of the tendon, where the elbow joint is superficial, and where an abnormal collection of fluid in the joint (or in the triceps bursa) sometimes shows itself.

The **triceps bursa** is situated deep (anterior) to the lower end of the triceps tendon.

The **shaft of the humerus** is felt with varying distinctness through the muscles which surround it.

It will be observed that no part of the shaft or of the proximal extremity of the humerus is subcutaneous.

The **medial and lateral epicondyles of the humerus,** being subcutaneous, are easily felt at the proximal portions of the medial and lateral aspects respectively of the elbow region.

The *medial epicondyle* is the more prominent, and, pointing practically in the same direction as the head of the humerus, it may give information as to the position of the head in a dislocation of the shoulder —unless the dislocation be complicated by a fracture of the humerus.

The **olecranon process of the ulna** is separated from the skin only by the **olecranon bursa,** and is therefore practically subcutaneous and easily felt.

The student should observe carefully that with the elbow EXTENDED the tip of the olecranon process and

the two humeral epicondyles lie practically in a *straight line*, whereas when the elbow is FLEXED the olecranon descends until its tip forms the apex of an approximately equilateral *triangle* of which the two epicondyles form the angles at the base. These anatomical relationships are important in the diagnosis of certain injuries in the elbow region (supra-condylar fracture, dislocation of elbow).

The **head of the radius** is felt immediately distal to the lateral humeral epicondyle in the depression which appears on the lateral portion of the posterior aspect of the elbow region when the forearm is extended.

It may be felt to rotate if the forearm be alternately pronated and supinated.

The **elbow joint** is represented ANTERIORLY by a line drawn parallel and immediately distal to the crease which is seen on the anterior aspect of the elbow region when the forearm is flexed.

POSTERIORLY, the radio-humeral portion of the elbow joint can be felt as a distinct interval between the head of the radius and the humerus, in the depression referred to above.

The **proximal radio-ulnar joint** is felt on the posterior aspect of the elbow region as an interval between the head of the radius and the olecranon process of the ulna.

The **shaft of the radius** is felt indistinctly through the muscles of the forearm in its *proximal third*, while its *distal third* is practically subcutaneous.

The **dorsal border of the shaft of the ulna** is subcutaneous throughout, and can be traced by palpation *from* the olecranon process *to* the styloid process.

The **distal extremity of the ulna.**

I. The **head** is the rounded subcutaneous prominence easily seen and felt on the medial portion of the dorsal aspect of the wrist region when the hand is pronated.

II. The **styloid process**, which is subcutaneous, is felt slightly distal and considerably ventral to the head.

The **distal extremity of the radius.**

I. The **lateral aspect** of the distal extremity of the radius is felt continuous with the distal end of the shaft of the bone.

II. The **styloid process** is felt immediately distal to the lateral aspect of the main portion of the distal extremity.

Palpation of the process with the thumb vigorously abducted will demonstrate the fact that, unlike the styloid process of the ulna, that of the radius is not subcutaneous, being overlaid by the tendons of the abductor pollicis longus and the extensor pollicis brevis (page 112).

The student should mark the tips of both styloid processes, and should observe most carefully that the styloid process of the radius extends some little way—about $\frac{1}{2}$ in. (1·25 cm.)—distal to that of the ulna. This relationship is important in the diagnosis of certain injuries in the wrist region (Colles' fracture, dislocation of the wrist).

III. The **ridge between the volar and distal aspects** of

the distal extremity of the radius is felt somewhat indistinctly through the tendons on the lateral portion of the volar aspect of the wrist region, about 1 in. (2·5 cm.) proximal to the proximal margin of the thenar eminence (ball of the thumb).

IV. The **dorsal radial** (LISTER'S) **tubercle** is easily felt about the middle of the dorsal aspect of the distal extremity of the radius.

Four of the **bones of the carpus** which may be identified by palpation are those to which the transverse carpal (anterior annular) ligament is attached, and they are best examined from the palm. They are

- 2 on the radial side
  1. navicular
  2. greater multangular
- 2 on the ulnar side
  3. pisiform
  4. hamate

I. The **tuberosity of the navicular** (SCAPHOID) is felt about the middle of the proximal border of the thenar eminence or ball of the thumb.

II. The **ridge on the greater multangular** (TRAPEZIUM) is felt on deep palpation immediately distal to the tuberosity of the navicular. Not infrequently the ridge on the greater multangular and the tuberosity of the navicular are indistinguishable from each other, forming upon palpation a single bony prominence.

III. The **pisiform** is felt with ease at the proximal border of the hypothenar eminence or ball of the little finger. If the hand be allowed to hang passively in the flexed position with the muscles relaxed, the pisiform may be gripped and moved from side to side.

IV. The **hook of the hamate** (UNCIFORM) is felt somewhat indistinctly upon deep palpation about a finger's-breadth distal to the pisiform.

V. In addition to the above, the **triquetrum** (CUNEIFORM) is felt on the ulnar side of the wrist, dorsal to the pisiform and distal to the styloid process of the ulna.

The **transverse carpal (anterior annular) ligament** is represented by two parallel lines : one, indicating its PROXIMAL BORDER,

from the tuberosity of the navicular
to the pisiform ;

the other, indicating its DISTAL BORDER,

from the ridge on the greater multangular
to the hook of the hamate.

Both the situation and function of this ligament should be borne in mind when incisions into the hand are being planned.

The **metacarpals.**

I. The **bases** of the metacarpals are felt somewhat indistinctly through or between the extensor tendons at the back of the wrist.

The STYLOID PROCESS AT THE BASE OF THE 3RD METACARPAL is usually prominent.

II. The **shafts** of the metacarpals are felt at the back of the hand. They are overlaid by tendons to a considerable extent.

III. The **heads** of the metacarpals form the knuckles. The 3rd is the most prominent, indicating the existence of a transverse arch in the hand.

The **phalanges** are felt with ease, their heads forming the knuckles on the fingers.

Certain of the **skin creases** of the palm are of importance as landmarks. Those claiming our attention may be classified as follows :—

I. Creases at the wrist—
   (1) Proximal,
   (2) Distal.

II. Creases in the palm—
   (1) Radial longitudinal,
   (2) Proximal transverse,
   (3) Distal transverse.

III. Digital creases—
   (1) Proximal or basal,
   (2) Middle,
   (3) Distal.

The creases at the wrist and on the digits find their functional explanation in the flexion which is the principal movement in these regions. The radial longitudinal crease indicates the presence of a transverse arch in the hand, while the proximal and distal transverse creases reveal the existence of a longitudinal arch.

The PROXIMAL AND DISTAL CREASES AT THE WRIST are usually distinct. The *lunate* (semilunar) bone lies between them, in the middle of the wrist region.

The RADIAL LONGITUDINAL CREASE, or the "line of life," delimits the thenar eminence or ball of the thumb distally, medially and proximally.

The PROXIMAL TRANSVERSE CREASE, or the "line of the head," commences on the radial border of the palm, between the base of the index finger and the thumb, in common with the radial longitudinal line. It extends obliquely, medially and slightly proximally across the palm to end on the hypothenar eminence or ball of the little finger.

The DISTAL TRANSVERSE CREASE, or the "line of

the heart," commences on the ulnar border of the palm, proximal to the base of the little finger. It extends laterally and distally to end in the cleft between the index and middle fingers (as a rule).

The thumb, having but two phalanges, possesses only two digital creases (of any size), proximal and distal, and in their relationship to the joints they correspond to the middle and distal creases on the other digits. Each digital crease is usually multiple or complex.

The **distal radio-ulnar joint** is felt as a slight depression immediately lateral to the head of the ulna on the dorsal aspect of the wrist.

The **wrist joint** is situated deep to the proximal skin crease at the wrist.

The **mid-carpal joint** (between the proximal and the distal rows of carpal bones) lies deep to the distal skin crease at the wrist.

The relationship of the wrist joint and of the mid-carpal joint to the creases at the wrist should be clearly understood if it be recalled that the lunate bone lies between the two creases.

The **first carpo-metacarpal joint** is immediately proximal to the base of the 1st metacarpal bone.

The **metacarpo-phalangeal joints.**

I. On the DORSUM, since the knuckles are formed by the heads of the metacarpals, therefore the

metacarpo-phalangeal joints lie immediately distal to the knuckles.

II. In the PALM the metacarpo-phalangeal joints of the fingers are situated midway between the basal digital creases of the fingers *distally*, and *proximally* the transverse portion of the distal transverse palmar crease and a line continuing its main direction to the radial side of the palm.

If the student carry the basal digital creases of the fingers round to the dorsum the important fact that these creases are related to no joint whatever will be obvious.

The *metacarpo-phalangeal joint of the thumb* lies distal to the basal crease of the thumb.

The **inter-phalangeal joints.**

I. On the DORSUM, since the knuckles on the fingers are formed by the heads of the first and second phalanges, it follows that the inter-phalangeal joints lie immediately distal to the knuckles.

This applies equally to the *thumb*, which, however, has but two phalanges and a single inter-phalangeal joint.

II. In the PALM the inter-phalangeal joints of the fingers are situated immediately distal to the most distal of the minor creases which go to make up the middle and distal digital creases.

The single *inter-phalangeal joint of the thumb* is similarly related to the distal digital crease, there being no middle digital crease.

Since mobility and the power of grasping are the principal functional requirements of the hand and digits, therefore amputations and disarticulations here must be performed in such a way as to leave the

patient the longest stump possible. In order to achieve this object, " classical " or " book " operations should sometimes be modified or even abandoned in favour of some original procedure designed to meet the peculiarities of the individual case and based upon sound surgical and anatomical principles. For this an exact knowledge of the surface relations of the joints is essential.

The **tendons in the region of the wrist** are frequently divided in injuries in this region, and an accurate knowledge of their anatomy is of great importance in connection with the suturing of such divided tendons.

The study of the tendons will be greatly facilitated if they are rendered prominent by causing the muscles to contract against resistance.

I. The tendon of the **flexor carpi radialis** is seen and felt crossing the front of the wrist a little lateral to its middle, and proceeding towards the navicular bone. (It is not inserted into this bone, however.)

This tendon serves as a guide to

(1) the radial artery, which is felt pulsating just lateral to the tendon ;

(2) the median nerve, which lies immediately medial to the tendon ;

(3) the tendon of the flexor pollicis longus, which lies deep to the flexor carpi radialis.

II. The tendon of the **palmaris longus** is seen and felt crossing the middle of the front of the wrist ; it is therefore medial to that of the flexor carpi radialis. It may be traced to the proximal border of the transverse carpal ligament, into which it is partly inserted. It is usually smaller than the tendon of the flexor carpi radialis, and not infrequently it is absent altogether.

If present it may serve as a guide to the median nerve, which lies deep to it.

III. The tendon of the **flexor carpi ulnaris** is felt crossing the front of the wrist near the ulnar side, and may be traced to its insertion into the pisiform bone.

It serves as a guide to the ulnar vessels and nerve, which lie immediately ~~medial~~ lateral to it at the wrist, but above the wrist are deep to it.

IV. The tendons of the **flexor digitorum sublimis** to the middle and ring fingers are seen and felt, if the fingers and wrist be flexed against resistance, between the palmaris longus (or flexor carpi radialis if the palmaris be absent) and the flexor carpi ulnaris, and in a somewhat deeper plane than they. Traced distally, they are lost by passing deep to the transverse carpal ligament.

The tendons of (V.) the **abductor pollicis longus** (EXTENSOR OSSIS METACARPI POLLICIS) and (VI.) the **extensor pollicis brevis** (EXTENSOR PRIMI INTERNODII POLLICIS) are seen and felt at the radial side of the wrist when the thumb is abducted. The tendon of the abductor is lateral to that of the extensor. Since they lie in contact with each other, some difficulty may be experienced in distinguishing the one from the other, but as a rule a finger nail can be inserted between them.

Deep to these two tendons are three important structures :

(1) the styloid process of the radius ;

(2) the radial collateral (external lateral) ligament of the wrist joint, extending distally from the styloid process ;

(3) the radial artery, crossing between the tendons and the ligament.

The tendon of the abductor pollicis longus is traced

to its insertion into the base of the 1st metacarpal, while that of the extensor pollicis brevis may be palpated with some difficulty to its insertion into the base of the proximal phalanx of the thumb.

VII. The tendon of the **extensor pollicis longus** (EXTENSOR SECUNDI INTERNODII POLLICIS) is seen and felt a short distance medial to those of the abductor and extensor brevis pollicis. It may be traced to its insertion into the base of the distal phalanx of the thumb.

Deep to this tendon at the wrist are the tendons of the extensor carpi radialis longus and brevis (*vide infra*), and, lateral to these, the radial artery.

The "ANATOMICAL SNUFF-BOX" is the small depression seen, if the thumb be well abducted, between the tendon of the extensor pollicis longus and that of the extensor pollicis brevis. It contains the second portion of the radial artery (see page 120).

The tendons of (VIII.) the **extensor carpi radialis longus** and (IX.) the **extensor carpi radialis brevis** are felt crossing the back of the wrist immediately lateral to the dorsal radial tubercle. They are somewhat difficult to identify, but are best brought out by dorsiflexing the wrist against resistance. The extensor carpi radialis longus is the more lateral of the two tendons, and is traced to its insertion into the base of the 2nd metacarpal, while the extensor carpi radialis brevis, which is medial to the other, is traced to its insertion into the base of the 3rd metacarpal. The difficulty in identifying these tendons is due in part to the fact that they are crossed superficially by the tendon of the extensor pollicis longus, as above mentioned. The dorsal radial tubercle, which is immediately proximal to this crossing, separates the tendon of the extensor carpi radialis brevis, which is

lateral to it, from that of the extensor pollicis longus, which is medial to it.

The tendons of (X.) the **extensor indicis proprius**, (XI.) the **extensor digitorum communis**, and (XII.) the **extensor digiti quinti proprius** are felt indistinctly crossing the back of the wrist between the dorsal radial tubercle and the head of the ulna. They are in the above order latero-medially, the extensor indicis proprius and the extensor digitorum communis tendons being related to the radius, while the extensor digiti quinti proprius is related to the distal radio-ulnar joint (see page 109). These tendons are somewhat more distinct on the back of the hand and fingers than at the wrist, but it is difficult to identify them individually. It may be noticed that two tendons go to the index finger and two to the little finger, whilst the middle and ring fingers receive but one.

XIII. The tendon of the **extensor carpi ulnaris** is felt crossing the back of the wrist near the ulnar side, and may be traced to its insertion into the base of the 5th metacarpal. It descends between the head and the styloid process of the ulna.

It will be noticed that whereas the styloid process of the radius is overlaid by the tendons of the abductor pollicis longus and the extensor pollicis brevis, that of the ulna is subcutaneous, being situated between the tendon of the flexor carpi ulnaris and that of the extensor carpi ulnaris, nearer the latter.

The **tendon sheaths on the front of the wrist and hand** are of great surgical importance by reason of the frequency with which they become infected. They may be considered under two headings :

A. Sheaths on the front of the wrist ;

B. Digital sheaths.

The SHEATHS ON THE FRONT OF THE WRIST are three in number :

(1) the sheath of the flexor carpi radialis ;

(2) the sheath of the flexor pollicis longus ;

(3) the common flexor sheath.

These three sheaths begin in the forearm about 1 in. (2·5 cm.) above the proximal border of the transverse carpal ligament (indicated by the distal skin crease at the wrist), and extend distally beneath that ligament into the palm of the hand.

I. The **sheath of the flexor carpi radialis** is scarcely of sufficient clinical importance to warrant detailed consideration of its surface anatomy.

II. The **sheath of the flexor pollicis longus** is represented by a thick line which commences over the tendon of the flexor carpi radialis (deep to which that of the flexor pollicis longus lies), about 1 in. (2·5 cm.) proximal to the distal skin crease at the wrist. From this point it is drawn distally to the medial border of the thenar eminence, then along the distal border of the most prominent portion of the ball of the thumb (not along the radial longitudinal line). Finally, the line is continued along the middle of the palmar aspect of the thumb to the base of its distal phalanx, where the tendon is inserted.

III. The **common flexor sheath** encloses all the tendons of the long flexors of the fingers. Its proximal end is represented by a transverse line drawn from the tendon of the flexor carpi radialis to that of the flexor carpi ulnaris, slightly convex proximally, the summit of the convexity reaching about 1 in. proximal to the distal skin crease at the wrist. From each end of this transverse line a line is drawn distally into the

palm. The lateral of these two lines is drawn as far as a point in the long axis of the index finger at the level of the middle of the free edge of the web of the fully abducted thumb. The medial line is drawn to a point in the long axis of the little finger, at the same level as the lateral line, or very slightly distal to that. The distal extremities of the two lines are now joined, the resulting quadrilateral figure representing approximately the common flexor sheath.

If now the *transverse carpal ligament* be marked in it will be seen that this ligament crosses the tendon sheaths on the front of the wrist about their middle. For this reason if the common flexor sheath be distended with fluid a characteristic dumb-bell-shaped swelling results, the constriction in the middle being due to the overlying ligament upon either side of which the swelling is evident, in the forearm and in the hand, respectively.

The DIGITAL SHEATHS of each finger (for that of the thumb see above) is represented by a thick line drawn from the base of the terminal phalanx along the middle of the palmar aspect of the digit.

In the case of the *little finger* this line is continued proximally to join the medial portion of the surface representation of the common flexor sheath, since the digital sheath of the little finger is continuous with the common flexor sheath (*cf.* the thumb).

In the case of the *index finger* the line ends at the proximal transverse crease of the palm; in the case of the *ring finger*, at the distal transverse crease; and in the case of the *middle finger* it ends at a level corresponding to that of the other two.

These surface markings illustrate the highly important fact that the digital sheath of the thumb and that of the little finger are in open communication with the corresponding sheaths in the palm. There is

thus an open path for infections to spread from these digits into the palm and forearm. Moreover, these sheaths exhibit variations from the typical arrangement, and one variation which is of considerable clinical significance is that in which the digital sheath of the index, middle or ring finger is continuous with the common flexor sheath. Tenosynovitis in such a finger is obviously just as liable to spread proximally as in the case of the thumb or little finger ; and, since the presence of this variation cannot be ascertained, tenosynovitis should always be treated as a condition fraught with grave possibilities.

The precise limits of the digital sheaths of the index, middle and ring fingers should be carefully noted, for incisions into these sheaths should not be prolonged beyond the limits of the sheaths themselves. If the latter mistake be made, the infection, instead of being checked, may be further disseminated. This is of especial moment at the proximal extremity of the sheaths ; it applies to the other sheaths also.

It will be observed from the surface marking that there is an interval of little over $\frac{1}{2}$ in. (1·25 cm.) between the distal extremity of the common flexor sheath and the proximal extremities of the digital sheaths of the index, middle and ring fingers.

The surface marking of the digital sheaths illustrates the fact that each is related to the proximal portion of the pulp of the finger. On this account an infection of the pulp (one form of whitlow) may lead to tenosynovitis ; moreover, the latter complication may result from a deep incision into the pulp being carried so far proximally that the digital sheath is opened.

The **tendon sheaths on the dorsum of the wrist and**

hand, while not so liable to acute infections as are those on the front, nevertheless suffer a more chronic form of inflammation, commonly as a result of strain; furthermore, a not uncommon cystic swelling on the back of the wrist known as a "ganglion" is believed to have its origin in one of these sheaths.

There are no sheaths on the dorsum of the digits; they are confined to the neighbourhood of the wrist.

Typically they are six in number, and are arranged as follows:—

one for the ABDUCTOR POLLICIS LONGUS and the EXTENSOR POLLICIS BREVIS,
one for the EXTENSOR CARPI RADIALIS LONGUS ET BREVIS,
one for the EXTENSOR POLLICIS LONGUS,
one for the EXTENSOR INDICIS PROPRIUS and the EXTENSOR DIGITORUM COMMUNIS,
one for the EXTENSOR DIGITI QUINTI PROPRIUS, and
one for the EXTENSOR CARPI ULNARIS.

It is obvious that there is a tendon sheath for each fascial compartment beneath the dorsal carpal (posterior annular) ligament.

The sheaths commence at a level approximately corresponding to that of the sheaths on the front of the wrist, and they extend distally for varying distances into the back of the hand, but not beyond its middle, as a rule.

By applying the foregoing general statement to the surface anatomy of the various tendons on the dorsum of the wrist and hand a sufficiently accurate idea of the surface anatomy of the sheaths will be obtained.

The **axillary artery** can be marked in throughout its length only with difficulty owing to the configuration

of the axilla, and in general practice it is rarely if ever necessary to do so. Nevertheless, owing to the fact that the third portion of the axillary artery sometimes requires to be ligated—for example for the arrest of haemorrhage in certain accidents—the student must be able to place his finger readily and accurately upon this portion of the vessel, as it lies posterior to the slight swelling raised by the coraco-brachialis in the lateral wall of the axilla when the arm is abducted. The pulsations of the artery are felt here, since it is not covered by muscles.

It will be recalled that the axillary artery ends at the level of the inferior border of the tendon of the teres major by becoming the brachial artery. Since the teres major is the lowest muscle forming the posterior wall of the axilla, it follows that the axillary artery ends and the brachial artery begins deep to a point in the groove behind the coraco-brachialis muscle at the level of the inferior margin of the posterior axillary fold. The third portion of the artery may be represented on the surface by a line conforming to the above facts.

The surface marking of the **axillary vein** may be inferred from its relationship to the artery.

To mark in the **brachial artery** the arm should be abducted to a right angle. The artery is indicated by a line

from the point above indicated

to a point about $\frac{1}{2}$ in. (1·25 cm.) distal to the middle of the bend of the elbow, since the brachial artery bifurcates not precisely opposite the elbow joint, but at the level of the neck of the radius.

In the (upper) arm the pulsations of the brachial artery may be felt deep to the medial border of the belly of the biceps, while at the elbow they are felt medial to the tendon of the same muscle, particularly if the elbow be extended.

The surface marking of the artery brings out the fact that as it descends through the (upper) arm its relationship to the humerus alters, so that whereas in the proximal part of the arm the artery is medial to the bone, in the distal part the artery is anterior to the bone. On this account the artery is compressed against the humerus by pressure exerted LATERALLY in the *proximal* third of the arm, LATERALLY AND POSTERIORLY in the *middle third* of the arm, and POSTERIORLY in the *distal third* of the arm.

The **radial artery** is represented by a line
from the point of bifurcation of the brachial artery
to a point just medial to the tip of the styloid process of the radius,
thence dorsally, immediately distal to the same process, and
finally, distally, over the "anatomical snuff-box"
to the proximal extremity of the space between the 1st and 2nd metacarpals.

The latter is identified by palpation, and there the artery runs through to the palm.

The artery is felt pulsating immediately proximal to the wrist, lateral to the tendon of the flexor carpi radialis, which is the guide to it. This is the common situation for the clinical examination of the pulse because here (1) the vessel is very superficial and (2) it rests upon the distal extremity of the radius, which forms a firm background against which it may be

compressed. In this respect compare it with the external maxillary artery (page 36), the superficial temporal artery (page 18), and the femoral artery (page 149).

If the fingers follow the artery up along the forearm its pulsations will soon become impalpable, the vessel lying deep to the brachio-radialis (supinator longus) muscle.

Not infrequently the pulsations of the artery are felt in the " snuff-box." Its surface marking shows that it enters the " snuff-box " by passing deep to the tendons of the abductor pollicis longus and extensor pollicis brevis, and leaves it by passing beneath the tendon of the extensor pollicis longus.

The **ulnar artery** is represented upon the surface as follows:—

LINE 1 is drawn *from* the medial epicondyle of the humerus

to a point just lateral to the pisiform bone.

LINE 2 is drawn *from* the point of bifurcation of the brachial artery

to the junction of the proximal and middle thirds of line 1.

The angle at the junction of the two lines is well rounded off.

LINE 2 represents the *proximal* third of the artery, and the DISTAL TWO-THIRDS OF LINE 1 represents the *distal two-thirds* of the artery.

The surface marking shows that the vessel lies deep to the flexor carpi ulnaris, the tendon of which is the guide thereto.

The **superficial volar (palmar) arch**, it will be

remembered, is formed chiefly by the ulnar artery. It therefore begins at the termination of the ulnar artery, and the main portion of the arch ends at the ball of the thumb.

The arch is indicated on the surface by a line

from the point representing the termination of the ulnar artery

to the distal portion of the medial border of the ball of the thumb,

the line being convex distally and the summit of the convexity being at a point in the mid-line of the palm at the level of the middle of the free edge of the web of the abducted thumb.

The student will notice that the summit of the superficial volar arch is at the same level as the distal extremity of the common flexor sheath, but he should realise that the arch and its branches (together with the digital branches of the nerves) are superficial to the tendons in the palm. This is of obvious significance in connection with wounds of the palm, and the situation of the arch may well be borne in mind when incisions into the palm are being planned.

The surface markings of the arteries may advantageously be retained while the nerves are being marked in, for in this way certain important relationships may be recalled and visualised. For this reason it is convenient to study the nerves next, and thereafter the superficial veins, certain groups of lymph nodes being finally considered in relation to the veins.

Since the principal **nerves** of the upper limb are terminal branches of the cords of the brachial plexus, and since these branches usually arise in relationship with the third portion of the axillary artery, the lines

representing the surface marking of the nerves may all commence close to that vessel—*i.e.* in the groove behind the coraco-brachialis, above the level of the inferior border of the posterior fold of the axilla. An exception to this will be made in the case of the axillary (circumflex) nerve, owing to its course posteriorly through the quadrilateral space.

The **musculo-cutaneous nerve** is represented by a line
from the groove behind the coraco-brachialis, above the inferior margin of the posterior axillary fold,
running distally and laterally
to a point lateral to the tendon of the biceps at the bend of the elbow.

At the latter point the musculo-cutaneous nerve pierces the deep fascia and becomes the lateral cutaneous nerve of the forearm. The fact that the line crosses the swellings formed by the coraco-brachialis and the biceps recalls that the nerve pierces the former muscle and runs deep to the latter.

The **axillary (circumflex) nerve** is represented by a horizontal line across the posterior and lateral aspects of the shoulder region, at a level just above the mid-point between the tip of the acromion process and the insertion of the deltoid muscle (page 102).

The **median nerve** is marked in as follows. With the arm abducted a line is drawn
from the groove behind the coraco-brachialis, above the inferior margin of the posterior axillary fold,

to a point on the anterior aspect of the elbow, midway between the tendon of the biceps and the medial epicondyle, and

thence to the middle of the anterior aspect of the wrist, and into the palm for about 1 in. (2·5 cm.).

The arteries being marked in, the line representing the median nerve should conform to the following neuro-vascular relations, of which the surface marking will serve to remind the student:—

The median nerve lies lateral to the third portion of the axillary artery and to the proximal half of the brachial artery. About the middle of the (upper) arm the nerve crosses superficial or deep to the brachial artery to run medial to it in the distal half of the (upper) arm.

At the elbow the median nerve lies medial to the terminal portion of the brachial artery, which separates it from the tendon of the biceps, and a short distance distal to the elbow it crosses superficial to the commencement of the ulnar artery, from which it is separated by the deep head of the pronator teres, since the median nerve runs between the two heads of the pronator teres while the ulnar artery passes deep to both heads of that muscle.

It will be observed that at the wrist the median nerve is just medial to the tendon of the flexor carpi radialis, but on a deeper plane, being deep to the tendon of the palmaris longus if that muscle be present.

The **ulnar nerve** is indicated by a line

from the groove behind the coraco-brachialis muscle, above the inferior margin of the posterior axillary fold,

to the posterior aspect of the medial epicondyle of the humerus, and

thence to a point just lateral to the pisiform bone, and into the palm for about $\frac{1}{2}$ in. (1·25 cm.).

The line indicating the ulnar nerve should conform to the following relations, which the student should visualise:—

The ulnar nerve runs along the medial side of the third portion of the axillary artery and of the proximal half of the brachial artery, separating from the distal half of this artery to pass behind the medial epicondyle of the humerus, where it may be felt and where it is particularly exposed to injury.

Below the elbow the ulnar nerve is rapidly approached by the proximal third of the ulnar artery, and it lies immediately medial to the distal two-thirds of that artery.

To mark in the **radial (musculo-spiral) nerve** it is best to begin by indicating the point where it pierces the lateral intermuscular septum, at the junction of the proximal and middle thirds of a line

from the insertion of the deltoid

to the lateral epicondyle of the humerus.

A line is drawn

from the above point,

running obliquely proximally and medially, across the posterior aspect of the upper arm,

to the groove behind the coraco-brachialis, above the inferior margin of the posterior axillary fold.

Another line is drawn

from the point above mentioned

to the anterior aspect of the lateral epicondyle,

where the nerve ends by bifurcating into its superficial and deep branches (radial and posterior interosseous).

The upper portion of the line of the radial nerve conforms to the fact that the nerve lies posterior to the third portion of the axillary artery and to the uppermost part of the brachial artery.

The **superficial branch of the radial nerve** (**the radial nerve**) is represented by a line

from the point of bifurcation of the radial (musculospiral) nerve

to the junction of the middle and distal thirds of the radius (anterior aspect),

then winding obliquely dorsally and distally

to the lateral portion of the back of the hand, where it divides into its terminal branches.

The surface marking should conform to the fact that this nerve lies along the lateral side of the middle third of the radial artery.

The **superficial veins** of the arm may be rendered prominent and easily studied by applying a constricting agent, such as a folded handkerchief, lightly round the arm just below the shoulder, so as to compress the superficial veins at the point of application and render the veins distal to that point engorged, without at the same time compressing the deeper lying brachial artery. This object is furthered by alternately clenching and opening the hand.

The principal superficial veins of the arm are (1) the CEPHALIC VEIN, on the lateral side of the limb, and (2) the BASILIC VEIN on the medial side. These

veins commence in the hand and run along the radial and ulnar borders of the forearm respectively. One or both veins may be double in the forearm, and occasionally the terms *radial* and *ulnar* are applied to them in this region.

Above the elbow the basilic vein runs medial to the belly of the biceps, and about the middle of the upper arm it pierces the deep fascia; the cephalic vein runs lateral to the belly of the biceps and finally in the delto-pectoral groove to the infra-clavicular fossa, where it pierces the costo-coracoid membrane.

In addition to these a much smaller and more irregular MEDIAN VEIN runs up the middle of the anterior aspect of the forearm, and is joined distal to the elbow by the *deep median vein* which pierces the deep fascia, coming from the deep veins of the limb.

The arrangement of the superficial veins at the elbow is of especial clinical importance, since a vein in this region is usually selected for intravenous work. The pattern varies greatly in different individuals, but in most instances it will be found to belong to one of two types, or a modification thereof.

Type I. Below and slightly lateral to the middle of the elbow the median vein divides into (1) the MEDIAN CEPHALIC, which runs proximally and laterally to join the cephalic vein just above the elbow, and (2) the MEDIAN BASILIC, which runs proximally and medially to join the basilic vein just above the elbow.

Type II. A MEDIAN CUBITAL vein springs from the cephalic vein distal to the elbow, runs obliquely proximally and medially across the front of the elbow, and joins the basilic vein proximal to the elbow. The median vein ends in the median cubital.

Naturally the most prominent vein is selected for

intravenous work, and that is usually the median basilic or the median cubital, as the case may be. It should be carefully observed and borne in mind that either of these veins crosses superficial to the brachial artery, from which it is separated only by a sheet of deep fascia called the *lacertus fibrosus* (bicipital fascia), which extends from the tendon of the biceps to the medial aspect of the proximal end of the forearm.

The **epitrochlear lymph nodes** are one or two in number, and are related to the basilic vein just proximal to the medial epicondyle of the humerus. They are therefore superficially situated.

The **delto-pectoral lymph nodes** are a small inconstant group related to the cephalic vein in the delto-pectoral groove on the anterior aspect of the shoulder region.

Swelling and tenderness of the epitrochlear or of the delto-pectoral nodes may be of considerable significance in cases of infection of the hand.

The **axillary lymph nodes** are of great clinical importance, and an examination of these nodes should be as systematic and thorough as a rectal or a vaginal examination.

From the point of view of a digital examination the axillary nodes are best classified according to their relationship to the vessels, and hence to the walls, of the axilla, as follows :—

(1) related to the main portion of the axillary vessels, and hence to the lateral wall of the axilla—the **central or lateral group ;**

(2) related to the highest portion of the axillary vessels, and hence to the apex of the axilla —the **apical group**;

(3) related to the lateral (long) thoracic vessels, and hence to the angle between the anterior and medial walls of the axilla—the **pectoral group**;

(4) related to the subscapsular vessels, and hence to the posterior wall of the axilla—the **subscapular group.**

In addition to these well-defined groups there are scattered nodes throughout the axilla.

The student should gently push his hand up into the axilla and visualise the relationship of each group of nodes to the examining fingers. When examining the axillary nodes the arm should be but slightly abducted. Free abduction tightens the axillary fascia and this impedes the examination.

The axillary nodes may be enlarged in a variety of conditions, amongst which may be mentioned (1) infections of the upper limb and (2) cancer of the breast.

CHAPTER V

THE INFERIOR EXTREMITY

For the bony **points of the pelvis** see pages 61 and 62.

The **great trochanter of the femur** is felt on the lateral aspect of the hip region, of which it is the most lateral bony point. The top of the great trochanter is to be marked in, and will be observed to lie about a hand's-breadth below the tubercle on the crest of the ilium, and on approximately the same level as the pubic tubercle. The degree of prominence of the great trochanter is increased if the gluteal muscles be atrophied (wasted), and of course it is displaced in dislocations of the hip and certain other conditions (*vide infra*).

Related to the great trochanter are one or more **bursae**, which are sometimes diseased.

The **lesser trochanter of the femur** is palpable with difficulty from behind, the thigh being extended and rotated medially.

The **natal cleft** is the deep groove between the buttocks. In the *upper* part of the cleft the COCCYX is palpable, while in its *lower* part is the ANAL ORIFICE.

The **gluteal fold** is the transverse groove delimiting the buttock inferiorly. This groove crosses the

inferior border of the gluteus maximus in such a way that whereas medially the groove is at a lower level than the border of the muscle, laterally the groove is above the border of the muscle, the two crossing about the mid-line of the thigh.

Alteration in the degree of prominence of the gluteal fold occurs in certain abnormal conditions—for example wasting of the gluteus maximus from infantile paralysis.

The **tuberosity of the ischium** is felt upon deep palpation through the distal portion of the gluteus maximus muscle just above the medial portion of the gluteal fold.

With the thigh extended the tuberosity is covered by the inferior portion of the gluteus maximus, but when the thigh is flexed the border of the muscle slips up off the tuberosity which is then subcutaneous.

Superficial to the ischial tuberosity is a **bursa** which may become diseased.

Methods of expressing the anatomical inter-relationships of the important bony points about the hip region, and of detecting departures from the normal.

The most important abnormal conditions affecting the hip region involve either the hip joint or the neck of the femur or both. Owing to their depth from the surface and their abundant clothing of soft parts these cannot be examined satisfactorily by direct methods such as palpation. If the equipment be available, the X-rays furnish valuable information, but in general practice recourse must frequently be had to one or more indirect methods which are based

upon certain normal anatomical relationships obtaining between the bony points of this region. Moreover, it will be understood that most of the abnormal conditions referred to, involving, as has been mentioned, the hip joint or the neck of the femur or both, result in some displacement of the great trochanter. For this reason all the indirect methods of examination referred to are, as it were, focussed upon the great trochanter, and are designed to demonstrate its normal relationships to other bony points and to detect departures therefrom. While several methods are described and the student is advised to familiarise himself with them all, it is not usually necessary to employ more than one or perhaps two of them in any given case. The reason for their multiplicity is that under certain circumstances some methods are preferable to others. For example, some necessitate moving the patient while others do not. The indications for the use of, and the value of, each method will be discussed by the teachers of surgery.

In all these methods, instead of drawing lines, tapes or pieces of string may be laid between the various bony points, but in order that he may obtain a permanent mental conception of them the student should draw the lines as directed.

I. **M'Curdy's Line** is a line drawn laterally from the pubic tubercle, at right angles to the mid-line of the body.

From the fact already observed that the top of the great trochanter is on the same level as the pubic tubercle it follows that M'Curdy's line normally passes over (or near) the top of the great trochanter.

Considerable departure from this relationship indicates vertical displacement of the great trochanter, the displacement being upwards (proximally) or

downwards (distally) according to whether the trochanter is displaced above or below the line.

II. **Chiene's Lines.** One of these lines joins the two anterior superior iliac spines; the other joins the tops of the two great trochanters.

Normally these two lines are parallel.

If they are not parallel, one of the trochanters is vertically displaced; and, the affected side being known, if on that side the two lines converge, the displacement is upwards (proximally), whereas if they diverge, the displacement is downwards (distally).

III. **Nélaton's Line** is drawn

from the anterior superior iliac spine

to the ischial tuberosity,

passing over the lateral aspect of the hip region.

Normally this line passes over (or near) the top of the great trochanter.

Considerable departures from this relationship indicate displacement of the great trochanter; the precise significance of such departures, however, must usually be ascertained by one of the other methods. For example, if the top of the great trochanter be above the line, the condition may be due to its being displaced upwards or backwards; if the trochanter be below the line, the displacement may be downwards or forwards; while if the displacement be upwards and forwards or downwards and backwards, the normal relationship between trochanter and line may be preserved.

IV. For marking in **Bryant's Triangle** the patient must lie flat upon his back.

(1) A line is drawn from the anterior superior iliac spine over the lateral aspect of the hip region, perpendicular to the surface of the table upon which the patient is lying.

(2) A line is drawn from the top of the great trochanter to meet line (1) at right angles.

Line (2) is measured.

The procedure is repeated on the opposite side and the two measurements are compared. In the absence of a measuring tape a piece of string will reveal any difference between the two measurements without recording the actual figures.

A considerable difference between the measurements on the two sides indicates vertical displacement of the great trochanter on one side. The affected side being known, if the measurement on that side be less than that on the sound side, the displacement is upwards (proximally); if the measurement on the affected side be the greater, the displacement is downwards (distally).

(3) The triangle is completed by drawing the hypotenuse

from the anterior superior iliac spine

to the tip of the great trochanter.

Line (3) is measured.

The same is done on the opposite side, and the measurements are compared.

A considerable difference between the measurements on the two sides indicates an antero-posterior displacement of one of the great trochanters. The affected side being known, if the measurement on that side be greater than that on the sound side, the displacement is backwards; if the measurement on the affected side be the less, the displacement is forwards.

It is clear that of these four methods Nélaton's line alone requires that the patient be moved, while it should be obvious that Chiene's lines and Bryant's triangle might fail to reveal a bilateral displacement of equal degree on the two sides.

The **medial and lateral condyles of the femur** are subcutaneous and are palpable at the proximal portions of the medial and lateral aspects respectively of the knee region.

The **adductor tubercle** is felt at the proximal and posterior part of the medial femoral condyle. It should be palpated from above downwards, and if necessary the student should refer to a dried bone. It may not be easy to identify.

It is utilised in the marking of the femoral artery (page 149), and it indicates the level of the epiphyseal line at the distal extremity of the femur.

The **medial and lateral condyles (tuberosities) of the tibia** are subcutaneous and are palpable at the distal portions of the medial and lateral aspects respectively of the knee region.

The **patella** is subcutaneous throughout and therefore easily palpable. Superficial to the distal portion of the bone is the **prepatellar bursa**, which is the seat of disease in the condition known as " housemaid's knee."

Bearing in mind the connections of the patella with the quadriceps femoris muscle and with the ligamentum patellae, the student should observe that with the knee flexed or actively extended the patella is practically immovable, whereas if the knee be passively extended the patella is movable both from side to side and from above downwards.

The **tuberosity (tubercle) of the tibia** is an easily palpable rounded elevation on the anterior aspect of the proximal extremity of the tibia, about 2 in. (5 cm.) distal to the inferior border of the patella.

It indicates the level of

(1) the head of the fibula,

(2) the bifurcation of the popliteal artery.

The **ligamentum patellae** is felt extending

from the inferior border of the patella

to the tuberosity of the tibia.

It is most easily felt if the knee be actively extended.

Superficial to the distal portion of the ligamentum patellae is the **superficial infrapatellar bursa,** while deep to the same portion of the ligament is the **deep infrapatellar bursa.**

With the knee flexed to a right angle a *depression* is seen on each side of the ligamentum patellae. At these depressions the KNEE JOINT is very superficial.

With the knee actively extended the **tendon of the quadriceps femoris** is felt extending down to its insertion into the proximal border of the patella.

The patella is retained in position mainly by the tendon of the quadriceps femoris and the ligamentum patellae. The muscle has the power of lengthening and shortening, while the ligament has not. Therefore, as the student should observe, in all positions of the knee the distance between the patella and the tibial tuberosity remains unaltered, whereas the patella glides upon the femur in such a manner that in flexion of the knee the proximal portion of the articular

surface of the distal extremity of the femur is palpable proximal to the patella; the latter bone, however, ascends during extension so as to cover this surface.

It is obvious that in a transverse fracture of the patella the quadriceps femoris tends to pull the proximal fragment proximally, the distal fragment being retained *in situ* by the ligamentum patellae. Clearly the position of passive extension, in which the quadriceps is relaxed, is the position most conducive to the reduction of this displacement, while flexion or any attempt at active extension will tend to increase the displacement.

Deep to the tendon of the quadriceps femoris is the *suprapatellar bursa.*

The **knee joint** is felt as a slight gap at the *medial* and *lateral* sides between the corresponding condyles of the femur and the tibia.

Anteriorly, it is situated deep to the middle of the ligamentum patellae.

The **suprapatellar bursa**, which almost invariably communicates freely with the knee joint and surgically forms a part thereof, extends about a hand's-breadth proximal to the proximal border of the patella, lying deep to the tendon of the quadriceps femoris. Because of this, a wound in the anterior aspect of the distal portion of the thigh, by involving the suprapatellar bursa, may infect the knee joint. As already mentioned, the knee joint is very superficial at each side of the ligamentum patellae.

The **head of the fibula** is felt to be subcutaneous at the postero-lateral aspect of the knee, at the level

of the tuberosity of the tibia. It is best felt from behind.

The **neck of the fibula** is felt immediately distal to the head of the bone.

The **tendon of the biceps femoris** may be traced by palpation from the proximal portion of the posterior aspect of the knee region, distally and laterally to its insertion into the head of the fibula.

The tendon of the biceps femoris and the proximal extremity of the fibula form important guides to the common peroneal (external popliteal) nerve (see page 153).

The **tendons of the semitendinosus and semimembranosus** may be traced by palpation from the proximal portion of the posterior aspect of the knee region distally and medially towards their insertion into the medial aspect of the proximal extremity of the tibia.

The tendon of the semitendinosus is lateral to that of the semimembranosus, and being on a more superficial plane is therefore the more prominent.

The **anterior border of the tibia** is sharp, subcutaneous and easily followed by palpation

from the tuberosity of the tibia

to the medial malleolus.

It is not usually perfectly straight.

The **medial surface of the shaft of the tibia** is likewise subcutaneous, except at its proximal extremity. It is

crossed obliquely, however, by the great saphenous vein (page 151).

The **shaft of the fibula** is subcutaneous only in its distal portion, proximal to the lateral malleolus.

This portion of the fibula should be examined with care, for it is commonly fractured (Pott's fracture).

The **medial and lateral malleoli** are subcutaneous and prominent, and are to be carefully palpated.

The tip of the lateral malleolus should be observed to be farther distally and farther posteriorly than that of the medial malleolus.

The lateral malleolus in particular is an important landmark in certain amputations of the foot (Syme, Pirogoff).

Surgical measurements of the leg.

Such measurements are carried out usually with the object of detecting shortening (sometimes lengthening) of the limb, and it must be understood that the essential feature of such measurements is not the actual figure but a comparison with the corresponding measurement of the other limb (that other limb being normal), records being kept for the purpose of recording progress in some cases. The student should actually practise these measurements, using a piece of string if a measuring tape be unavailable, since a comparison of the measurements on the two limbs can be made without recording the actual figures.

I. **Apparent shortening or lengthening** of a leg is brought about by certain adventitious circumstances, such as tilting of the pelvis.

It is revealed by comparing the measurement
from the umbilicus
to the tip of the medial malleolus on both sides.

It is not detected, however, on comparing the measurement from the anterior superior iliac spine to the medial malleolus. The student should take the trouble to understand why this is so.

II. **Real shortening (or lengthening)** of the leg is shown by comparing the measurement
from the anterior superior iliac spine
to the tip of the medial malleolus on both sides.

III. **To ascertain if the shortening be in the lower leg,** a comparison is made of the measurement
from the proximal edge of the medial tibial condyle
to the tip of the medial malleolus on both sides.

If there be real shortening of the limb, but not of the lower leg, then the thigh must be shortened. This is checked by the following measurement.

IV. **To ascertain if the shortening be in the thigh,** a comparison is made of the measurement
from the anterior superior iliac spine
to the distal edge of the medial femoral condyle on both sides.

V. **To ascertain if there be shortening of the shaft of the femur,** a comparison is made of the measurement
from the top of the great trochanter
to the distal edge of the lateral femoral condyle on both sides.

If there be shortening of the thigh, but not of the shaft of the femur, the shortening must be due to some abnormal condition about the head or neck of the femur, such as a dislocation of the hip or tuberculosis of the hip joint with absorption of the head of the femur.

The above measurements have been described as though the source of the shortening were unknown and the various measurements had to be made in order to ascertain its situation. But in many cases disease or injury which may produce shortening is known to be present, such as a fracture of the femur or tuberculosis of the hip joint, and it is desired merely to ascertain whether or not shortening is actually present. Under such circumstances it is obvious which measurements should be made.

It should be borne in mind that small differences between the two sides—for example a difference of $\frac{1}{2}$ in. (1·25 cm.) in the total length of the limb—may be normal, and that therefore only considerable differences are of significance, as a rule.

The **ankle joint** can usually be felt between the tendons on the front of the ankle region as a slight depression situated about $\frac{1}{2}$ in. (1·25 cm.) proximal to the tip of the medial malleolus.

The joint is somewhat superficial at each side of the tendo calcaneus, and therefore fluid in the joint may cause swelling in this situation.

Since deformities of the feet, congenital (such as club-foot) and acquired (such as flat-foot) alike, are very much commoner than deformities of the hand, and since their diagnosis, and sometimes their treatment, becomes the duty of the general practitioner, the student will understand that he is to possess considerable familiarity with the **bones of the foot**, especially their surface anatomy.

The **calcaneus** (**os calcis**).

I. The **posterior surface,**

II. the **medial surface,**

III. the **lateral surface** and

IV. the **inferior surface**

may all be felt from aspects of the heel sufficiently indicated by their names, the inferior surface less distinctly than the others because of the overlying muscles of the sole of the foot.

V. The **sustentaculum tali** is felt as a small bony prominence distal to the tip of the medial malleolus. It should be marked. It is somewhat obscured to the touch by the tendon of the flexor digitorum longus which crosses it.

VI. The **trochlear process** (PERONEAL TUBERCLE) is a small tubercle felt on the lateral aspect of the calcaneus, distal and anterior to the tip of the lateral malleolus. Sometimes it is so small as to be impalpable. Its relationship to the tendons of the peronei is referred to on page **146.**

VII. The **anterior extremity** (often called the *head* or the *greater process*) is felt on deep palpation anterior to the lateral malleolus; but it may be difficult to identify.

The **talus** (**astragalus**).

I. The **head** is palpable in two situations:

(1) antero-medial to the proximal portion of the lateral malleolus,

(2) immediately anterior to the medial malleolus.

It should be identified carefully in the latter situation, and marked.

II. The **superior surface of the body** is felt indistinctly on the anterior aspect of the ankle region, distal

to the distal extremity of the tibia, the foot being plantar-flexed.

The tuberosity of the navicular (scaphoid) is the most prominent and important landmark in the foot. It is easily seen and felt on the medial aspect of the foot, distal and anterior to the tip of the medial malleolus. If the foot be actively inverted the tendon of the tibialis posterior may be traced to the tuberosity of the navicular. The latter should be marked.

The plantar calcaneo-navicular (inferior calcaneo-scaphoid or "spring") ligament is the most important ligament in the foot, because of its relationship to the longitudinal arch. Its principal attachments are to

(1) the sustentaculum tali and

(2) the tuberosity of the navicular.

It is therefore indicated on the surface by a line joining these two bony points.

The head of the talus will be observed to lie above the level of the plantar calcaneo-navicular ligament, upon which indeed the bone partly rests. It will be readily seen and understood that the head of the talus is also on a higher level than the bony attachments of the ligament, so that a line joining the sustentaculum tali, the head of the talus and the tuberosity of the navicular presents a convexity upwards or proximally. The tendons of certain muscles (*vide infra*) may be observed to pass below the plantar calcaneo-navicular ligament; they support it.

In flat-foot these muscles are weakened; the ligament can then no longer support the head of the talus which descends, stretching the ligament and flattening

the longitudinal arch of the foot. In club-foot the muscles and ligament are commonly contracted, and the foot is bent so that the tuberosity of the navicular approaches nearer to the sustentaculum tali than normal.

The **base of the first metatarsal** is the prominence felt on the medial aspect of the foot, about as far anterior to the tuberosity of the navicular as the sustentaculum tali is posterior to it. It may be a little difficult to identify.

The **first or medial cuneiform** is felt somewhat indistinctly between the tuberosity of the navicular and the base of the first metatarsal.

The **base of the fifth metatarsal** is identified with ease as the most prominent landmark on the lateral aspect of the foot.

The **shafts of the metatarsals** are felt somewhat indistinctly on the dorsum of the foot, through or between the extensor tendons.

The **mid-tarsal (Chopart's) joint** is represented by a line drawn across the dorsum of the foot

from a point immediately posterior to the tuberosity of the navicular

to the mid-point between the tip of the lateral malleolus and the base of the fifth metatarsal.

Chopart devised a method of disarticulating the foot through this joint.

The **cuboid** is felt somewhat indistinctly on the lateral aspect of the foot posterior to the base of the fifth metatarsal and anterior to the lateral extremity of the line marking the mid-tarsal joint.

The **tarso-metatarsal joint** is of consequence principally because the disarticulations of the foot associated with the names of Hey and of Lisfranc are performed through it; however, these operations are not so popular to-day as heretofore.

The joint is difficult to mark. It is indicated by a line drawn across the dorsum of the foot

from immediately posterior to the base of the first metatarsal

to a point in line with the first inter-metatarsal space (the latter being identified by palpation);

then proximally in the line of this space for about $\frac{1}{2}$ in. (1·25 cm.);

next, laterally to a point in line with the second inter-metatarsal space;

then distally for about $\frac{1}{4}$ in. (0·6 cm.);

finally, sweeping in a curve, convex distally, to a point immediately posterior to the base of the fifth metatarsal.

The irregularity in this line opposite the second metatarsal is in conformity with the peculiar manner in which the base of that metatarsal is received into a species of socket formed by the three cuneiforms.

The **metatarso-phalangeal joints** are of most consequence in the case of the *great toe*, which may be disarticulated here. They lie immediately distal to the knuckles formed by the heads of the metatarsals.

Many of the **tendons in the ankle region** can be distinguished satisfactorily only when their muscles are in action.

A. Tendons on the ANTERIOR aspect of the ankle (from medial to lateral side).

I. The tendon of the **tibialis anterior** may be traced to its insertion into the first cuneiform and the base of the first metatarsal.

II. The tendon of the **extensor hallucis longus** may be followed to its insertion into the base of the terminal phalanx of the great toe.

III. The tendons of the **extensor digitorum longus** may be followed towards their insertions into the lateral four toes.

IV. The tendon of the **peroneus tertius** may be traced to its insertion into the base of the fifth metatarsal. It is of minor importance and may be absent.

B. The tendons on the LATERAL aspect of the ankle are those of the **peroneus longus** and **peroneus brevis.** With the foot actively everted these tendons may with care be followed distally, posterior and inferior to the lateral malleolus, and then anteriorly along the lateral aspect of the foot.

Posterior to the lateral malleolus the tendon of the peroneus brevis is anterior and deep to that of the peroneus longus, while on the lateral aspect of the foot the tendon of the peroneus brevis is superior to that of the peroneus longus, the trochlear process intervening between the two tendons.

The tendon of the peroneus brevis may be traced to its insertion into the base of the fifth metatarsal; that of the peroneus longus, after running anteriorly as far as the cuboid bone, disappears by turning into the sole, where it lies deeply and is therefore impalpable. Nevertheless, its course should be

marked on the skin of the sole from the cuboid bone to the insertion of the tendon into the first cuneiform and base of the first metatarsal (*cf.* tibialis anterior).

C. The tendon on the POSTERIOR aspect of the ankle is the **tendo calcaneus** (ACHILLIS), which is very easily traced down to its insertion into the posterior part of the calcaneus. A *bursa* lies deep to the distal portion of the tendon, between it and the ankle joint.

At the depression on each side of the tendon the *ankle joint* is fairly superficial, and when it is full of fluid these depressions may be obliterated.

D. Tendons on the MEDIAL aspect of the ankle.

I. The foot being actively inverted the tendon of the **tibialis posterior** may be palpated as it passes posterior and distal to the medial malleolus, then superior to the sustentaculum tali to its insertion into the lower part of the navicular. It may be utilised as a guide to this bone. If the plantar calcaneonavicular ligament be marked in, the tendon of the tibialis posterior will be observed to run first lateral and then inferior to the ligament, of which it is the most important support.

II. The tendon of the **flexor digitorum longus** and (III.) that of the **flexor hallucis longus** also pass posterior and then distal to the medial malleolus. Behind the medial malleolus the tendon of the flexor digitorum longus lies immediately posterior to that of the tibialis posterior. The tendon of the flexor hallucis longus is posterior to that of the flexor digitorum longus (the two being separated by the posterior tibial vessels and the tibial nerve).

Distal to the medial malleolus, the tendon of the flexor digitorum longus crosses the medial aspect of the sustentaculum tali, while the tendon of the flexor

hallucis longus runs immediately distal to that bony prominence.

Thereafter both tendons run below the plantar calcaneo-navicular ligament, which they help to support, and pass deeply into the sole of the foot, where their further surface marking is of minor importance.

These two tendons cannot be traced very satisfactorily by palpation, but their course should be marked on the surface in conformity with the facts stated above.

With the toes actively extended the small fleshy belly of the **extensor digitorum brevis** may be felt anterior to the lateral malleolus. Its situation should be observed in order that it may never be mistaken for an abnormal swelling.

The student should remember that there are **tendon sheaths** round the tendons at the ankle and in the sole of the foot, but the details of their surface anatomy are not so important as in the case of the tendon sheaths of the wrist and hand. Like the latter they are liable to septic or tuberculous infection (tenosynovitis).

The **femoral ring** lies deep to the inguinal ligament, about 1 in. (2·5 cm.) from the pubic tubercle.

The **femoral canal** extends distally from the femoral ring for about $\frac{1}{2}$ in. to 1 in. (1·25 cm. to 2·5 cm.).

The **fossa ovalis (saphenous opening)** is represented by an ellipse,

$1\frac{1}{2}$ in. (3·75 cm.) in *length*,
1 in. (2·5 cm.) in *breadth*,
with its *long axis* set vertically
and its *centre* about $1\frac{1}{2}$ in. (3·75 cm.) distal and lateral to the pubic tubercle.

The surface anatomy of the femoral ring and canal and of the fossa ovalis is of the very greatest importance in connection with femoral hernia.

The **femoral artery (common femoral and superficial femoral)** is marked in with the thigh flexed, abducted and rotated laterally. A line is drawn

from the mid-inguinal point
to the adductor tubercle.

The PROXIMAL TWO-THIRDS of this line represents the femoral artery, its PROXIMAL THIRD representing the artery in the *femoral* (*Scarpa's*) triangle, while its MIDDLE THIRD represents the artery in the *adductor* (*Hunter's*) *canal*.

Immediately distal to the inguinal ligament the vessel may be compressed against the superior ramus of the pubis, and haemorrhage from the lower limb may be controlled by this manoeuvre. It is sometimes convenient, for example during certain operations, to examine the pulse in this situation.

The **profunda femoris artery** arises from the femoral artery about $1\frac{1}{2}$ in. (3·75 cm.) distal to the inguinal ligament.

The surface anatomy of the **femoral vein** may be deduced with sufficient accuracy by recalling that it

presents the following relationships to the femoral artery :—(1) at the base of the femoral triangle the vein is medial to the artery (between the artery and the femoral ring) ; (2) at the apex of the femoral triangle the vein is posterior to the artery ; (3) in the adductor canal the vein is postero-lateral to the artery.

To mark the **popliteal artery** one must first identify by palpation the proximal angle of the popliteal fossa, where the tendons of the biceps femoris and of the semimembranosus and semitendinosus diverge. A line is drawn

from a point immediately medial to the proximal angle of the popliteal fossa

to a point in the mid-line of the leg, at the level of the distal end of the tuberosity of the tibia, the latter bony point being palpated on the anterior aspect of the limb (page 136).

The surface marking of the popliteal vein is practically the same as that of the artery, to which it lies for the most part superficial or posterior.

The **posterior tibial artery** is indicated by a line

from the point of bifurcation of the popliteal artery

to a point mid-way between the tip of the medial malleolus and the posterior extremity of the calcaneus.

At its termination the artery lies between the tendon of the flexor digitorum longus anteriorly and that of the flexor hallucis posteriorly (being separated from the latter, however, by the tibial nerve), and, being somewhat superficial, its pulsations may often be felt

in this situation. An examination of the pulse here may yield valuable information in certain cases in which gangrene of the foot is threatened or feared.

The artery lies deep to the superficial muscles of the calf.

The **anterior tibial artery** is indicated by a line
from a point immediately lateral and distal to the distal end of the tuberosity of the tibia
to a point on the anterior aspect of the ankle midway between the medial and lateral malleoli.

The **dorsalis pedis artery** is represented by a line
from the point indicating the termination of the anterior tibial artery
to the posterior extremity of the space between the first and second metatarsal bones.

This space is identified by palpation, and here the artery runs through to the sole.

Its pulsations may be palpable on the dorsum of the foot, and the proximal portion of the artery is usually crossed superficially by the tendon of the extensor hallucis longus.

The **great saphenous vein**, if visible, will be seen to commence on the medial side of the foot and to pass anterior to the medial malleolus. Next, running up the leg, it crosses the medial aspect of the tibia obliquely antero-posteriorly so that it runs postero-medial to the knee joint. Finally it extends up the medial aspect of the thigh, inclining anteriorly, to the fossa ovalis, through which it pierces the deep fascia to end in the femoral vein.

The **small saphenous vein**, if visible, will be seen to commence on the lateral side of the foot and to pass posterior to the lateral malleolus, running straight up the back of the leg to the popliteal fossa, where it pierces the deep fascia to end in the popliteal vein.

Both saphenous veins are important because of the frequency with which they become varicose.

The **femoral (anterior crural) nerve** (in the thigh) is indicated by a line drawn from a point superficial to the inguinal ligament about 1 in. (2·5 cm.) lateral to the mid-inguinal point, distally for about 1 in. (2·5 cm.).

The **sciatic nerve** (in the thigh) is represented by a line

from a point mid-way between the top of the great trochanter and the ischial tuberosity

to a point in the mid-line of the thigh, about half-way down.

The exact level of the bifurcation of the sciatic nerve varies in different individuals.

Tenderness may be elicted upon pressure along the line of the sciatic nerve in some cases of sciatica. It should be observed that the sciatic nerve is stretched when the thigh is flexed and the knee extended, while it is relaxed when the thigh is extended and the knee flexed.

The **tibial nerve (internal popliteal and posterior tibial)** is represented by a line

from the point of bifurcation of the sciatic nerve, down the middle of the popliteal space and calf of the leg

to a point mid-way between the tip of the medial malleolus and the posterior end of the calcaneus.

The popliteal and posterior tibial arteries being marked in, the line representing the tibial nerve should conform to the relationships existing between the nerve and these arteries. It will be recalled (1) that the nerve crosses superficial (*i.e.* posterior) to the popliteal artery from lateral to medial side (being separated from the artery, however, by the popliteal vein); (2) that it crosses the proximal portion of the posterior tibial artery superficially from medial to lateral side; (3) and that below the medial malleolus it lies posterior to the posterior tibial artery, between that vessel and the tendon of the flexor hallucis longus.

The **common peroneal (external popliteal) nerve** is indicated by a line from the point of bifurcation of the sciatic nerve, along the tendon of the biceps femoris, posterior to the head of the fibula, and finally around the lateral aspect of the neck of the fibula to its anterior aspect, immediately distal to the head.

The nerve can usually be felt as it lies posterior to the head of the fibula, or lateral to the neck, or in both situations, and, since the nerve is a branch of the sciatic, tenderness may be elicited here in some cases of sciatica. The nerve is particularly exposed to injury here, being subcutaneous and related deeply to bone. It should be compared in this regard with the ulnar nerve at the elbow. It may even be injured by the unskilful application of a splint.

The **deep peroneal (anterior tibial) nerve** is represented by a line

from the point of bifurcation of the common peroneal nerve

to a point on the anterior aspect of the ankle immediately lateral to the mid-point between the medial and lateral malleoli.

The line representing the anterior tibial artery being marked in, the line of the deep peroneal nerve should conform to the fact that the nerve is lateral to the proximal third of the artery, anterior to its middle third and lateral to its distal third.

Of the **popliteal lymph nodes** one or two may be *superficial*, related to the small saphenous vein before the latter pierces the deep fascia.

The majority, however, are *deep*, related to the popliteal vessels, and are difficult to examine by palpation.

The **inguinal lymph nodes** may be classified as follows :—

I. Superficial inguinal nodes—

(1) proximal superficial inguinal nodes,

(2) distal superficial inguinal nodes.

II. Deep inguinal nodes.

The **superficial inguinal nodes** are situated superficially, as their name implies, and are easily examined by palpation.

The PROXIMAL SUPERFICIAL INGUINAL NODES are a horizontal chain of nodes related to the inguinal ligament. Normally they can be felt. They are divided, more or less arbitrarily, into two groups—(a) *medial* and (b) *lateral*, of which the medial group is of particular clinical importance since its nodes

drain (i) the external genitalia in both sexes (including the lower end of the vagina in the female) and (ii) the anal canal. The nodes related to the medial half of the inguinal ligament are therefore enlarged in certain affections of these organs.

The DISTAL SUPERFICIAL INGUINAL NODES are a vertical chain related to the proximal extremity of the great saphenous vein.

The **deep inguinal nodes** are related to the proximal extremity of the femoral vein, and there is usually one in the femoral canal. As they lie deeply beneath the fascia lata they cannot be examined satisfactorily by palpation as a rule.

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